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AUTOMATIC, CHANGEABLE ELECTRIC SIGNS.

AMONG the numerous characteristic American business methc ls, so frequently and justifiably admired by Europeans, there are few which are so distinctly unique and effective as the scale on which advertising is carried on in this country. It has been the key to innumerable commercial successes, the building up of daily newspapers, magazines and trade journals, and has given coloring and animation, artistic and otherwise, to our cities and their immediate surroundings. Thousands of media and as many methods have been resorted to by the enterprising tradesmen, depending chiefly upon the kind of product to be advertised, the class of people to be reached and even the time of the year when the public should be addressed on the merits of a production.

If one were asked, however, to state briefly the secret of judicious advertising, he might express it by the one word, "variety"—variety not alone in the media employed for advertising purposes, but variety, also, in the manner of presenting the claims of superiority of a product to the public. The latter tire quickly of one and the same announcement; they crave for change and novelty. And this explains why the stationary, dumb electric sign, to which we have become accustomed, in spite of its brilliancy, no longer fascinates the public nor materially benefits the advertiser. The sign of to-day, like the editor or salesman, must talk to the people, and keep them interested by constantly presenting to them some new feature. Besides, advertising, as practised to-day, is very costly, one producer paying the enormous sum of $24,000 for an electric sign in New York city; and it is essential, therefore, in order that the advertiser might reap the greatest benefit from the space and time at his disposal, that new matter is presented to the public at frequent intervals.

It is the fulfillment of these requisites which gives the sign about to be described the highest place in the realm of advertising. It combines in an ingenious manner changeability, the automatic feature and extremely low operating cost, opening up a new era in electric sign advertising.

The signs, instead of being composed of several elements, each having the shape of a letter, consist of a number of boxes or monograms, shaped as shown in Fig. 2. The method of constructing these boxes and the arrangement of the lamps is the invention of Mr. Geo. L. Mason, and is the result of many years of painstaking labor.

FIG. 1.—A NIGHT VIEW OF THE LARGEST ELECTRIC SIGN.

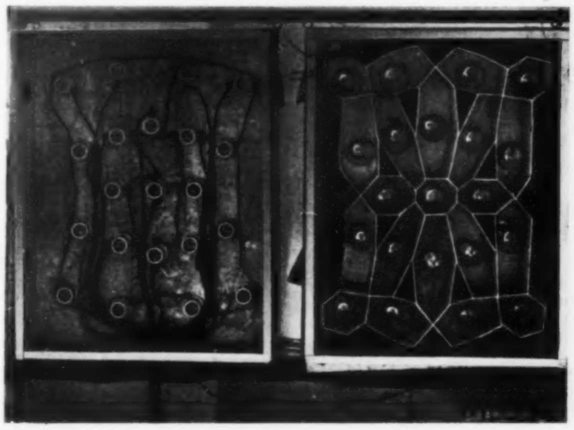


FIG. 2.—WIRING AND FRONT VIEW OF A MASON MONOGRAM.

As will be seen, each box or monogram is composed of a number of tin boxes or troughs, united in such a manner that any letter of the alphabet, or any number, may be formed. Within each trough is an incandescent lamp, of from 4 to 16 candle power, according to the size of the letter, and each trough is enameled white on the inside, thus acting as a reflector.

The compartments of which the letter is composed serve to concentrate the light along certain definite lines, obviating the blur which makes the ordinary electric sign so illegible at a distance. It has been found that a Mason letter can be distinguished twice as far as the old form of electric letter. Furthermore, on account of the compartments, only about one-half as many lamps as are necessary for the formation of an ordinary letter studded with lamps are needed, which reduces current consumption, and, therefore, the cost of operating the sign to about one half. There are 21 spaces or troughs to each monogram, and the same number of lamps. The largest number of lamps used for the formation of any letter is 13, and the average number for any letter of the alphabet is 8, which is about one-half the number needed for the formation of an ordinary letter 4 feet in height.

The lamp sockets protrude through the base of the troughs, and the wiring is hidden behind the plates supporting the troughs, as shown in Fig. 2. As the two lamps in the two lower troughs are always lighted at the same time, they are wired on one circuit, so that there are 20 circuits of one polarity leading from the box, besides one common return for all the lamps, making a total of 21 wires. As seen in Figs. 2 and 7, these are bunched together into a cable and are led to the automatic commutating devices shown in Fig. 5. As will be seen in the illustration, the commutators, one for each monogram, are all connected by a shaft and are electrically separated from each other by means of an insulating coupling. The commutators are each 14 inches in length, and consist of a revolving drum, on the periphery of which and insulated therefrom, are mounted the cop-

FIGS. 3 AND 4.—A TEN-LETTER SIGN PHOTOGRAPHED BY ITS OWN LIGHT ONE SECOND APART.

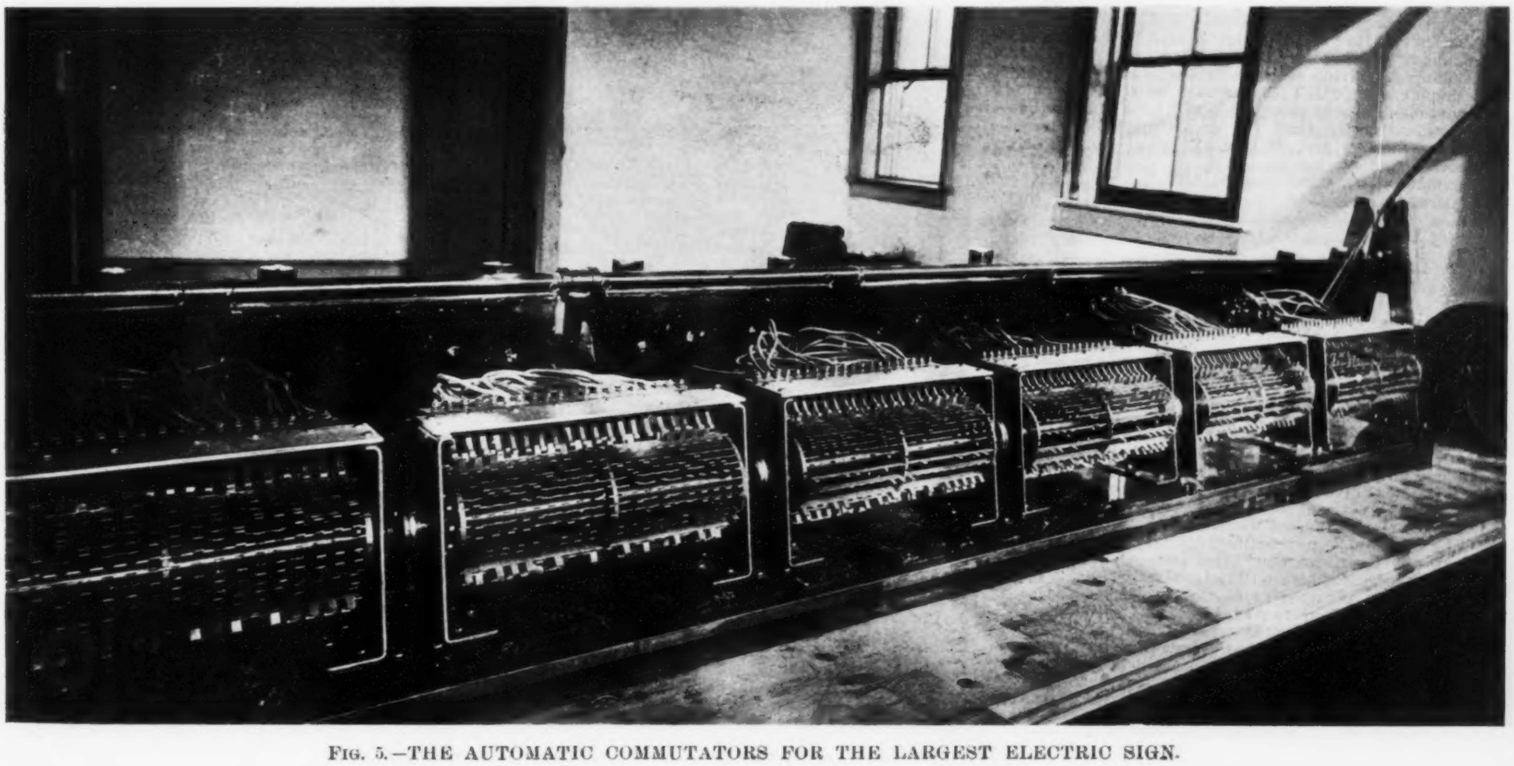


FIG. 5.—THE AUTOMATIC COMMUTATORS FOR THE LARGEST ELECTRIC SIGN.

per selecting bars, each having as many projections as it is intended to light lamps in a monogram. Each bar takes care of the lamps in one monogram, and, if it be desired, for example, to have 40 changes on the sign for one complete revolution of the drum, there must be 40 bars on the periphery. Above the drum a plate is mounted which supports 20 springs or fingers, making contact with the projections left on the bars. To these 20 springs the 20 wires from the box are connected, while the common return wire is directly connected to one side of the main circuit, thus placing the commutators in series with the main feeders and monograms. This is diagrammatically shown in Fig. 6, which explains the method of forming an H. As will be seen, only a certain number of teeth in the bar are left, these teeth corresponding to the lamps which are to be lighted. The dotted lines show the return wire which connects all the lamps and goes directly to one side of the main circuit. In the diagram only those lamps, wires and contact springs are shown which are required for the formation of the letter H.

If it be desired, after the changes have been prepared for all the monograms, to change a complete sentence, it is only necessary to take out one set of bars and replace them by new ones, representing other letters, and which are kept in stock. But little time is required for this operation, and it can be accomplished without the stopping of the machinery.

The commutators are revolved by a small motor, the speed of which is reduced by means of worm gearing. It is connected by means of a belt to an intermittent gear having as many teeth as it is desired to make changes on the sign during one cycle, and it is of such diameter and so adjusted that each time the one-tooth pinion enters its space on the gear the commutators are revolved so as to present a new word or sentence on the sign. It is so timed that the change is gradual, the sign never being in entire darkness, and a new sentence is shown every 10 seconds, two of which are taken up by the gradual change.

The company manufacturing and installing these monograms make a specialty of constructing signs for individual users, who install the same in front of or on the roofs of their stores, or even in show windows. They are enabled to talk to the public all the evening on any subject on which they may care to address them, changing the subject matter the next evening if they so desire. One of these signs, consisting of ten boxes, is shown in Figs. 3 and 4, the sign at one instant flashing out the word "Changeable" and a moment later the word "Monograms."

Besides these individual signs, however, the Mason Monogram Company, as the company is called, build large signs for general advertising purposes. The largest one constructed is located over the roofs of the two-story buildings at the northwest corner of 65th Street and Broadway, New York. This corner is one of the most prominent in the metropolis, as the surface cars transfer at this point and all the Sixth and Ninth Avenue trains pass the same. It has been estimated that from 300,000 to 400,000 persons pass this location daily. This sign, which is the longest electric sign in the world, consists of two rows of monograms, each row being 128 feet in length. There are in all 48 monograms on the sign, each 3 feet wide and 4 feet high. The total length of the sign is 256 feet. A night view of it is shown in Fig. 1. It may be of interest to cite the fact that before the company built this sign they erected a single letter on the Palisades 36 feet in height, and when illuminated it could be plainly read over a large part of the Island of Manhattan and for some distance down New York Bay. The cables from the separate boxes are led into the operating booth, the interior of which is shown in Fig. 7, which also illustrates the driving mechanism. On this sign 40 changes are made every 10 seconds, and no attendant is required for the operation of the sign.

On account of its automatic changeability and extremely low cost, there is a vast field of usefulness for these signs for display and advertising purposes. In conjunction with a keyboard, the signs are splendidly adopted for announcement purposes, such as the results of contests and elections, the signaling for carriages and between ships, etc.

Another feature of particular interest is the ease and cheapness with which the colors of the letters may be changed. Strips of glass are secured in front of the monograms, which may be changed from one color to another in a very short space of time. This method is far less costly than the employment of colored lamps, which is frequently an item of considerable importance.

In view of what has been said of this novel advertising and display device, it cannot be denied that it is in every sense "A Sign of the Times."

THE HISTORIC DEVELOPMENT OF THE ART OF MOSAIC.*

Mosaic is the combination of different colored small pieces of hard substances, such as marbles, stones, pastes of glass, etc., to form a design which may be either a geometrical pattern or a picture. There are really two divisions into which mosaic may be divided as far as the method of combination is concerned. The first is the arrangement of small cubes, by which the decorative result is arrived at, and the other is the arrangement of inlays, in which the various figures are cut out of a ground and filled in with another material or diverse colors of the same material. Though these are, broadly, the two main divisions, there are many different varieties of both of them.

The art has been practised from the very earliest times, and there are records of mosaic pavements in Egypt 2,300 years before Christ. Strange to say, there are, however, no remains of mosaic work to be seen among the ruins of the vanished civilization on the banks of the Nile; but nevertheless, in the Egyptian collection at Turin, there is the fragment of a mummy case, the pictures of which are executed in mosaic with wonderful precision and truth. The material is enamel, and the colors are of different hues, while the subject is one representing birds. It is believed to be the only example existing of Egyptian mosaic.

The Greeks were most proficient, and carried the art to its highest perfection. They diverted it from its original purpose, which was the embellishment of pavements, and their skillful practice in it led to its usurpation of the position of oil painting. It therefore became extensively used for the decoration of upright surfaces and ceilings. An Italian writer has divided mosaics into four classes, viz.: Tesselated and Sectile, applied to pavements generally, and Fictile and Vermiculated or Pictorial, applied to walls and ceilings. A particular kind of mosaic was used to adorn the pavement of a dining-hall. It was called *Asaroton*, and represented the crumbs and remains of a repast which would be lying on an unswept floor. It is supposed to have been introduced by Sosus, of Pergamus, the first artist in mosaic, of importance, of whom we hear.

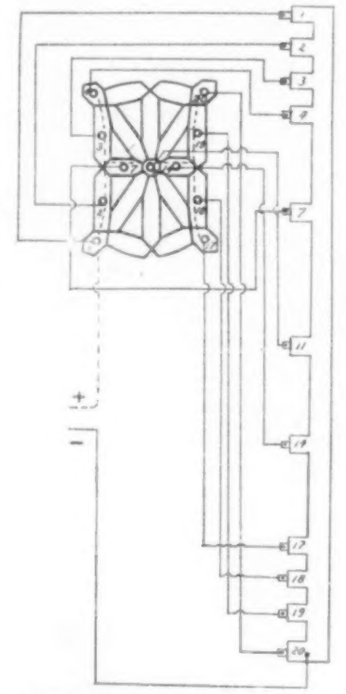


Fig. 6.—DIAGRAM SHOWING WIRES IN SERVICE FOR THE FORMATION OF THE LETTER H.

Mosaic was the most important decoration used in the Basilicas of the Roman Empire, and in the churches erected under Constantine and his successors, while it was also used with profusion in other public and private edifices.

The Greeks at first preferred marble to any other material, but in course of time, as they introduced new methods and ideas, they came to use glass in one form or another, and under certain circumstances bone, ivory, and mother-of-pearl. The main reason why marble was abandoned is not far to seek, for it is evident that chemical and mechanical mixtures of glass and colors, together with the advent of gold and silver leaf under the glass, produced a wonderful splendor and artistic effect previously unknown.

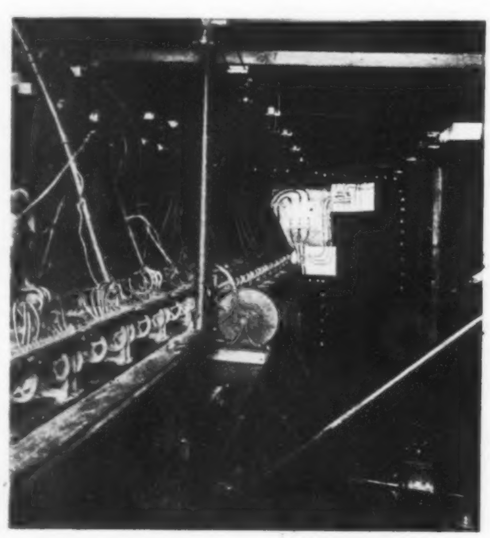


Fig. 7.—INTERIOR OF OPERATING ROOM.

From the fact of the impervious and inflexible character of the material, mosaic, whether in color or stability, experiences no change under the action of any kind of weather. It therefore has an excellent opportunity imparted to it for representing historical scenes, and of handing down a true pictorial account of important ceremonies. The Popes, by causing the finest paintings of the Vatican to be reproduced in mosaic at St. Peter's, have made assurance of their legacy to perpetuity.

M. Jules Labarte, in his "Hand Book of the Arts of the Middle Ages," says, "Mosaic was destined to perish by the hands of those who had carried it to perfection, since painting, restored by these great masters, proved too powerful a rival. Instead of perpetuating the gigantic figures of solemn, severe aspect, which portrayed the Saviour, the Virgin, and the Apostles, according to the type of the Byzantine school, the artists in mosaic endeavored by the most elaborate finish and minuteness to imitate the details of painting. But when once it departed from its sphere, mosaic experienced the fate of painting upon glass, and was almost entirely discontinued." Still, the art continued to flourish at Venice till nearly the end of the sixteenth century, having the support of the Senate and of Titian, the latter instructing the artists to restore the Byzantine mosaics of St. Mark's, and furnishing them with colored cartoons for that purpose.

The mosaics at St. Mark's, at Venice, are an incomparable series, and in them may be traced the progress of art, beginning with the eleventh century. In 1879, Ruskin wrote, "Every hour of my life, these mosaics become more precious, both for their art and their meaning;" and he raised a great deal of controversy through his action in opposing the authorities who were carrying out restoration schemes. Fortunately, he was successful in averting further injury, and the greatest care is now taken in maintaining the building in its integrity. The mosaics in question represent: The Wood of the Holy Cross Festival, Christ surrounded by the Prophets, the Doge, Clergy and People of Venice, three of the Apostles witnessing the Ascension (eleventh century work), the Virtues (sixteen in the series), the Four Evangelists, the Four Rivers of Paradise, King David and the Madonna, King Solomon and Ezechiel, Christ surrounded by the Principalities and Powers of Heaven, and other religious subjects.

The effort to reduce mosaic art to a representation of paintings made it necessary to improve the material, and therefore colored enamels of various shapes and sizes were introduced, and of different shades, with most delicate tints and half-tints. The end of the seventeenth century therefore witnessed the restoration to favor—to a great measure—of mosaic, and it was very widely used for the reproduction of the paintings of the great masters.

The mosaic found at Hadrian's Villa, near Tivoli, and now in the Capitoline Museum, shows the great perfection to which the early Greeks (it being Grecian work) attained in the art. One example represents a vase full of water, on the sides of which are four doves, one of which is in the act of drinking. It is composed entirely of cubes of marble without any admixture of colored glass, thus showing that it is some of the earliest work of its kind. A mosaic found at Pompeii represents three masked figures playing musical instruments, and it is formed of very small pieces of glass of different colors. The value of this work is enhanced by the artist's name—Dioscorides, of Samos—being worked upon it. A more remarkable mosaic was discovered in the House of the Faun, and it is now in the museum at Naples. It shows the progress of a battle between Greeks and barbarians, and Prof. Quaranta refers the picture to the battle of Issus. The Grecian leader is supposed to be Alexander the Great, and if this is so, the mosaic is probably the copy of a picture by Apelles, the only artist privileged to paint the Macedonian conqueror. Unfortunately, the work has suffered some damage, but it was in this mutilated state when discovered, and seems to have been under a process of reparation. The border represents a river, thought by some to be the Nile, and they think that the mosaic is probably a copy of a picture on the same subject, painted by Helena, an Egyptian female artist, and brought to Rome by Vespasian.

The finest mosaic pavement in England and one of the finest in Europe is to be seen at the Roman villa, Bognor, Sussex, where it was discovered in 1811. It represents an old man's head, a Medusa, a Ganymede, and a combat of lions. There are also some beautiful border designs, and the whole is in a state of excellent preservation. At the Roman villa at Northleigh, Oxfordshire, there are some very good mosaic pavements, and among the Roman antiquities in the British Museum there is a specimen which was found at Withington, Gloucestershire, and which depicts Neptune and other marine figures. In the Græco-Roman collection at the British Museum, there are tesselated pavements and mosaics, chiefly from Carthage and Halicarnassus, and among those from the latter place is a large specimen representing Aphrodite rising from the sea, and another, a large bay wreath containing words of felicity.

Among the discoveries of ancient mosaic in recent years, is the find, in 1896, in the island of Milos, of an excellent specimen in a splendid state of preservation, representing vegetables, birds, and fishes. In 1897, at Madaba, in Palestine, a valuable mosaic was discovered, which exhibited a plan of the Holy Land in the fifth or sixth century of our era, and which has enabled the exact site of the Church of St. Sepulcher—which was destroyed by the Persians A. D. 611—to be determined. In the same year, at Torre Annunziata, the village near Pompeii, a mosaic in very good condition was discovered, which represents a scene in a school of philosophy. In 1898, a very good example of Roman mosaic was unearthed at Silchester, near Reading, where most energetic excavations are proceeding, and last year (1899) more discoveries were made there of mosaic pavements of a simple pattern.

The Romans have left behind no more distinct traces of their occupation of the various countries than the numerous, and in most cases well-preserved, mosaic pavements of their edifices, which remain to us to-day as an evidence of their remarkable artistic power and clever mechanical skill.

The following list of medieval glass wall mosaics is considered by Prof. Middleton as embracing the chief examples of their kind:

Rome.—Fifth century work—St. Paulo fuori le mura, triumphal arch; St. Maria Maggiore, square pictures over nave columns, and triumphal arch. Sixth century—Saints Cosmas and Damian, apse. Seventh century work—St. Agnese, fuori le mura, apse, 626; St. Teodoro. Eighth century work—Baptistery of St. Giovanni in Laterano; Saints Nereus and Achilles. Ninth century work—St. Cecilia in Trastevere, apse; St. Marco, apse; St. Maria della Navicella, apse and "Chapel of the Column"; St. Prassede, triumphal arch; St. Pudenziana, 884. Twelfth century work—

* Communication by Guy Wilfrid Hayler, to the Society of Arts.

St. Clemente, apse; St. Francesco Romana, apse; St. Maria in Trastevere, apse. Thirteenth century work—St. Paoli fuori le mura, apse; St. Clemente, triumphal arch, 1297; St. Giovanni Laterano, apse by Jacopo de Turrita, 1290; St. Maria Maggiore, apse and western end by Jacopo da Turrita, 1292-1299, and Taddeo Gaddi. Fourteenth century work—St. Peter's, navicella in atrium, by Giotto; St. Maria in Cosmedin, on walls, by Pietro Cavallini, c. 1340.

Jerusalem.—Seventh century work—"Dome of the Rock," arches of ambulatory, 688. Eighth century work—Mosque of Al-Aska, on dome. Eleventh century work—"Dome of the Rock," base and cupola, 1027.

Milan.—Fifth century work—St. Ambrogio, Chapel of St. Satiro, vault. Sixth century work—St. Lorenzo, Chapel of St. Aquilinus, vault. Ninth century work—St. Ambrogio, apse, 832.

Florence. — Thirteenth century work — Baptistery vault, c 1225, by Fra. Jacopo; St. Miniato, apse and western front. Fourteenth century work—Baptistery, finished by Andrea Tafi.

Ravenna.—Fifth century work—Orthodox Baptistery, vault; Tomb of Galla Placida, vault, 450; Archbishop's Chapel, vault. Sixth century work—Arian Baptistery, vault; St. Apollinare Nuovo, apse and nave, with ninth century additions; St. Vitale, apse and whole sanctuary, 547; St. Apollinare in Classe, apse and nave, 549.

Constantinople.—Sixth century work—St. Sophia, walls and vault, *circa*, 550. Eleventh century work—St. Saviour, walls and domes.

Venice.—Twelfth century work—St. Mark's, narthex, apse, walls of nave and aisles. Fourteenth century work—Saints Giovanni e Paolo, in arch over effigy of Doge Morosini.

Fundi.—Fifth century work—Cathedral, apse.

Nola.—Fifth century work—Cathedral, apse.

Thessalonica.—Sixth century work—Church of St. George, apse, etc.; St. Sophia, dome and apse.

Trebizonde.—Sixth century work—St. Sophia, apse.

Mount Sinai.—Eighth century work—Chapel of the Transfiguration.

Cordova.—Tenth century work.—Nihrab (sanctuary) of Mosque.

Capua.—Twelfth century work—Cathedral, apse.

Torcello.—Twelfth century work—Cathedral, apse.

Murano.—Twelfth century work—Cathedral, apse.

Salerno.—Twelfth century work—Cathedral, apse.

Palermo.—Twelfth century work—Capella Palatina, began 1132, the whole walls; Church of La Martorana, vault.

Monreale.—Twelfth century work—Cathedral, the whole walls, 1170-1190.

Bethlehem.—Twelfth century work—Church of the Nativity, 1169.

Afalú.—Twelfth century work—Cathedral, apse, 1148.

Pisa.—Fourteenth century work—Cathedral, east apse by Cimabue, 1302; north and south apses, by his pupils.

RUSSIA'S INDUSTRIAL DEVELOPMENT.

By H. L. GEISSEL.

DURING the last ten years Russian industries have made marvelous progress. The Russian government recognized long ago that the home money market was not able at all to bring about the desired development, and it therefore favored systematically the introduction of foreign capital. The latter was especially welcome for the exploitation of the great mineral resources of the empire, for the establishment of engineering works, for the extension of the Russian railway nets, for the formation of powerful banking institutions, insurance companies, etc.

During a period of six years, from 1894 to 1899, no less than 927 joint stock companies were formed in Russia, namely:

Year.	No. of Companies.	Stock capital, Rubles.*	Bonds rubles.	Foreign companies.
1894......	63	54,600,000	19,500,000	3
1895......	94	116,600,000	33,200,000	1
1896......	131	197,300,000	36,000,000	24
1897......	136	192,900,000	50,200,000	25
1898......	176	229,800,000	53,900,000	28
1899......	327	358,400,000	78,100,000	70
Total...	927	1,149,600,000	270,900,000	151

* The Russian ruble equals 52 cents United States currency.

Taking stock capital and bonds together, we arrive at a total amount of 1,420,500,000 rubles, or $738,660,000, invested in stock companies during the above-mentioned period.

It is true that quite a number of these companies never engaged in business, while others were only conversions of already existing private firms into stock companies, and therefore should be left out of consideration. In spite of this, however, it is safe to estimate that at least 600,000,000 rubles were concentrated through the concession of Russian joint stock companies during the above six years.

On January 1, 1899, there existed altogether in Russia 1,181 stock companies, capitalized at 1,736,856,000 rubles. These 1,181 companies were divided among the various industries as follows:

	No. of companies.	Capital in rubles.
Mining and metallurgy....	300	531,000,000
Textile..................	215	311,000,000
Food products............	218	143,000,000
Chemical.................	60	78,000,000
Banking..................	52	280,000,000
Commercial...............	50	59,000,000
Wood pulp................	46	32,000,000
Transportation...........	44	61,000,000
Insurance................	21	41,000,000
All others...............	175	201,000,000
Total..................	1,181	1,737,000,000

Among the foreign companies formed in Russia from 1894 to 1899, 135 companies, with a capital of 450,000,000 francs, or about $90,000,000, were Belgian.

The total foreign capital invested in the above-mentioned 1,181 stock companies amounted to 2,075,000,000 francs, or nearly $415,000,000, divided among the different nations as follows:

	Francs.
French	792,000,000
Belgian	734,000,000
German	261,000,000
British	236,000,000
Dutch	18,000,000
United States	12,000,000
Austrian	11,000,000
Swiss	5,000,000
Swedish	4,000,000
Italian	2,000,000

Of this immense amount, at least fully two-thirds, or about $140,000,000, was invested during the period from 1894 to 1899.

What influence the investment of such huge sums has had upon the rapid development of Russian industries will best be seen from the following figures:

The production of the "manufacturing industries" in Russia amounted in 1877 to 541,000,000 rubles; ten years later, in 1887, to 802,000,000 rubles; 1892, to 1,010,000,000 rubles; and in 1897, to 1,816,000,000 rubles. The value of the output of the Russian textile mills rose from 298,000,000 rubles in 1877 to 464,000,000 rubles in 1887, to 582,000,000 rubles in 1892, and to 946,000,000 rubles in 1897. The metal industries produced goods to the value of 89,000,000 rubles in 1877, while ten years later, in 1887, the value was 113,000,000 rubles, which rose to 162,000,000 rubles in 1892, and to 311,000,000 rubles in 1897. The average annual increase thus amounted to 26,100,000 rubles from 1878 to 1887; 41,600,000 rubles from 1887 to 1892, and to 161,200,000 rubles from 1892 to 1897. Immense strides ahead were also made in the Russian mining industries. The production of bituminous coal aggregated the following amounts for the years cited:

	Poods.
1877............................	110,000,000
1887............................	277,000,000
1892............................	424,000,000
1897............................	684,000,000
1898............................	746,000,000

The production of naphtha increased from 13,000,000 poods in 1877 to 167,000,000 poods in 1887, 189,000,000 poods in 1892, 478,000,000 poods in 1897, and to 507,000,000 in 1898. The figures for pig iron are as follows:

	Poods.
1877............................	23,000,000
1887............................	36,000,000
1892............................	64,000,000
1897............................	113,000,000
1898............................	134,000,000

Too many columns would be necessary to enumerate the production of all the Russian industries.

The number of industrial works in European Russia was 30,333 in 1893, and 39,029 in 1897; the value of their output was 1,735,000,000 rubles in 1893, and 2,839,000,000 rubles in 1897, while the number of workmen employed in these industrial establishments rose from 1,582,904 in 1893 to 2,098,262 in 1897.

The period of this immense industrial development coincides with that covering the building up of the enormous state and private railway enterprises of the country, for from 1894 to 1900 no less than 1,273,000,000 rubles were expended in the construction of new lines and in the purchase of additional rolling stock.

But, in spite of this extension, Russia, in order to reach the level of other great European countries, would have to construct 80,000 versts (53,000 miles) more of railways, not including Siberia, and this only in proportion to population. And, taking area into consideration, the total still needed would be 200,000 versts (132,600 miles), at an annual cost of 240,000,000 rubles, calculating cost at 60,000 rubles per verst (0.663 mile) and spreading 12,000,000,000 rubles over fifty years; while in 1899 for state and private lines in European Russia 40,000,000 rubles were spent in construction.

The railways of Russia now practically run from the White to the Black Sea on the one hand, and from the Baltic to the Yellow Sea on the other. The vast expanse of territory thus covered, great portions of which may be said to be still but partially exploited or else entirely undeveloped, will need an increasing extension of subsidiary lines, some of which by their extent and importance partake more of the character of main thoroughfares.

The general progress has likewise been considerable. The number of passengers during 1899 was 75,710,000, or 5,000,000 more than in 1898. The freight traffic was 6,614,000 poods, or 10 per cent over the total of 1898. The rolling stock has increased since 1894 some 50 per cent, 290,000,000 rubles being assigned in this period for the purchase of engines and cars. Double lines have been laid down over 8,247 versts.*

During the same period the brandy monopoly was introduced, on account of which the government spent 72,500,000 rubles on new buildings and their outfit.

A direct result of this evolution was a heavy increase in the revenue of the state, and a feature hitherto unknown in the Russian budget, viz., a considerable surplus! The revenues derived from commercial taxes increased from 40,500,000 rubles in 1893 to 61,100,000 rubles in 1898, that is 50 per cent; while the customs house receipts grew from 147,100,000 rubles to 219,600,000 rubles, an increase of 49 per cent; and the receipts from the excise tax, which amounted to 345,900,000 rubles in 1893, rose to 449,600,000 rubles in 1898, an increase of 40 per cent. In almost the same ratio increased the receipts of the Post and Telegraph Service, namely, from 35,500,000 rubles in 1893 to 47,000,000 rubles in 1898, an increase of 32 per cent.

That such an immense industrial development created a demand for machinery is a matter of course. In 1899 the imports of machinery into Russia amounted to the enormous value of $58,200,000.

The magnitude of the foreign trade Russia transacts in machinery will be better understood by a few comparisons. In 1899 the imports of machinery into some leading European countries were as follows:

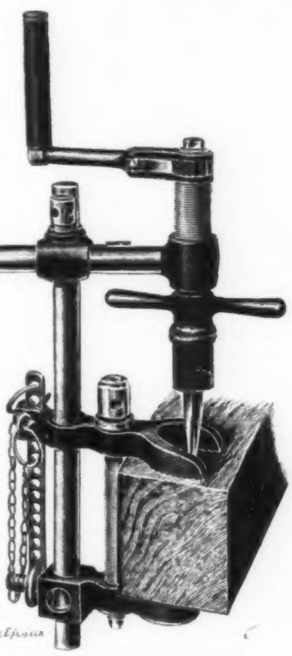
Great Britain (in round figures)....	$16,000,000
Germany	15,400,000
France	14,000,000
Austria Hungary	9,500,000
Or together	$54,900,000

From these figures it will be seen that Russia's machinery imports exceeded those of Great Britain, Germany, France and Austria-Hungary combined.

Up to the present time the great bulk of machinery imported into Russa has chiefly come from Germany and Great Britain. To the immense imports of 1899, the United States contributed less than 6 per cent.

There is every probability that the imports of all kinds of industrial machinery into Russia will continue to increase for years to come.

BRACE AND DRILLING POST.



DRILLING POST AND BRACE

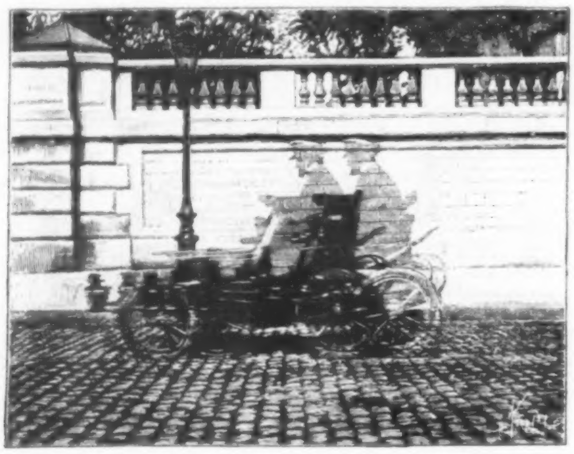
THE small drilling apparatus illustrated is of French origin, and is being introduced to the English market by Wallach Brothers, of Gracechurch Street. We are informed by a circular which accompanies the tool that, "by means of this machine holes of up to more than ½-inch diameter can be drilled in any kind of metal, by hand, without fatigue, almost without effort, with a rapidity equaled only by stationary machines, anywhere, in any position, in every direction, without having to be taken to pieces." Wonderful claims, expressed in more wonderful English! We take it that "up to more than ½-inch" means but little more than that diameter, for the machine is of light construction, the post being about 11-16-inch diameter, and the radius of the handle only 4¼ inches. The length of the post is 13 inches, of the horizontal arm 5½ inches, and the maximum distance of the drill from the post is 5 inches. The apparatus has, it will be seen, a clamp, the lower member of which can be turned at right angles on the post, so that the clamp may then be used on a vertical column, for example. The horizontal arm may also be moved into a variety of positions, and the drill spindle inclined to any angle, so that in combination with a few accessories some thirty to thirty-five different applications are possible. The spindle passes through a screwed sleeve which is employed for the feed, a ball-thrust bearing is provided, and a ratchet—which, by the way, is left-handed—allows of the drill being worked by a reciprocating motion when the handle cannot be revolved. For light work we can imagine that this apparatus might be found very useful.—Engineer.

To Remove Spots from Parquet Floors.—Just as numerous as the causes of the formation of spots on the parquet floors are the remedies for their removal. A wrong treatment usually causes the stains to grow larger or penetrate more deeply. The much-practised treatment with sharp lye to remove the evil is fallacious. If this has been done and no wax has been put on, the spot occasioned by the acid is removed with vinegar. If the dark color should remain, coat the place with diluted hydrochloric acid. But if wax has been applied to the spot it must first be taken off with a scraper. In the case of old oil stains, the place is moistened with benzine, and benzine is stirred with fine pipe clay, which is applied quite thick on the places. Benzine softens the oil and the pipe clay absorbs the softened oil, but the windows have to be opened to allow the benzine fumes to escape. In the case of fresh grease or oil stains cover them with blotting paper and place a hot flatiron on top, renew the paper until the stains have disappeared. Ink stains are removed with oxalic acid, likewise rust stains. But if the stains are of aniline ink, it is well to scrape off the spot, and put on moistened chloride of lime. It is preferable to have the sun rays act on it. When not certain of the origin of the stains and they look like fusty, a trial may be made with spirit of sal ammoniac or hydrochloric acid. Claret stains are removed with dissolved tartaric acid, at the same time it can be seen whether the wine had been artificially colored or not. If dyed with fuchsine only the natural color disappears upon the above treatment and the fuchsine remains, which will only give way to chlorine or to light.—Maler Zeitung.

* 1 verst equals 0·664 mile.

REGISTRATION OF THE SPEED OF AUTOMOBILES.

CONCERNING an ordinance of the prefect of police which forbids automobile carriages to exceed a certain speed in the streets, promenades and places frequented by pedestrians, there has been much discussion. In principle, it must be admitted that in the interest of the public such a measure ought to be taken, especially in view of the carelessness of certain chauffeurs, who, getting the idea into their heads that the street belongs to them, imagine that after sounding their trumpets they have a right to crush anybody. In practice the thing is more difficult, because the offense is based upon a simple estimate of the person who commits it, and because even in producing witnesses it is difficult to come to an agreement as to whether a carriage was running at a speed of 15 or 25 kilometers an hour or simply at too high a speed.



VIEW OF TWO SUCCESSIVE IMAGES OBTAINED FOR REGISTERING THE SPEED OF AUTOMOBILES.

There is nothing but an automatic registration that can give satisfaction to everybody, and so different methods have been proposed. On this subject the daily journals not long ago published some projects that were as impractical as they were unscientific, and so hey need not be considered. M. Gaumont, the well-known manufacturer of photographic and cinematographic apparatus, has, we think, devised the only really utilizable method. This consists in taking two photographs at a known interval of time, and in measuring the displacement upon the picture.

In order to make the principle better understood, we shall suppose in the first place that there have been placed alongside of each other two photographic apparatus that permit of taking two negatives of the carriage at an interval of a twentieth of a second. These two negatives having been developed we measure upon the first the distance that separates the center of the front wheel from the center of the hind one and find it to be 3 centimeters. We make the same measurement upon the carriage itself and find 1.5 meter. The ratio between the two measurements is 1 to 50; that is to say, we have an image of the object on a scale of one-fiftieth. Upon this image and upon any other made with an identical apparatus all the measurements relative to objects situated upon nearly the same plane as the carriage will be on a scale of one-fiftieth.

Let us now select a fixed point, say, a tree, in the vicinity of the carriage, and measure the distance that separates them. Upon the first negative we find that between this tree and the rear of the vehicle there is a space of 2 centimeters; and that upon the second negative there is a space of 3 centimeters. Hence we may conclude that the displacement of a point upon the image has been one centimeter in one-twentieth of a second; and since the scale is one-fiftieth it results that such displacement upon the ground has been 50 centimeters during the same time. This makes 10 meters to the second or 36 kilometers an hour.

It would evidently be somewhat impractical to use two stationary apparatus, and, besides, the position of the fixed point selected with respect to the carriage might give rise to error; so M. Gaumont does not operate in this way. His apparatus consists simply of a 9 by 12 centimeter hand camera provided with a shutter containing two slits instead of one, and separated by a space of a few centimeters. It is clear that with an apparatus of this kind each slit in the shutter that moves against the plate will give an image of the carriage in motion and that it will suffice to measure the distance between two identical points of each image in order to ascertain the displacement during the time that it has taken the shutter to drop. By construction, such time, which is in sum the velocity of the shutter, may be such as may be desired; and it will always be possible to select it in such a way that the distance between the two images shall be easy to measure, because we know that it is a question of automobiles of which the speed will vary between 20 and 40 kilometers. in fact, we must not forget the object that is proposed. It is not a question of measuring the distance traveled, but simply of ascertaining whether the chauffeur is within the limits of the regulation. Now such limits are sufficiently elastic to render it possible to accept an error of 2 or 3 kilometers, and the approximation is certainly sufficient to prevent any such error. It is only in cases in which the photograph is taken absolutely in face of the object that the measurement may be considered as exact. In all other cases there would evidently be a shortening of the lines due to perspective. The result would be that the error would accrue to the benefit of the chauffeur, who would seem to have been moving less quickly than he was in reality.

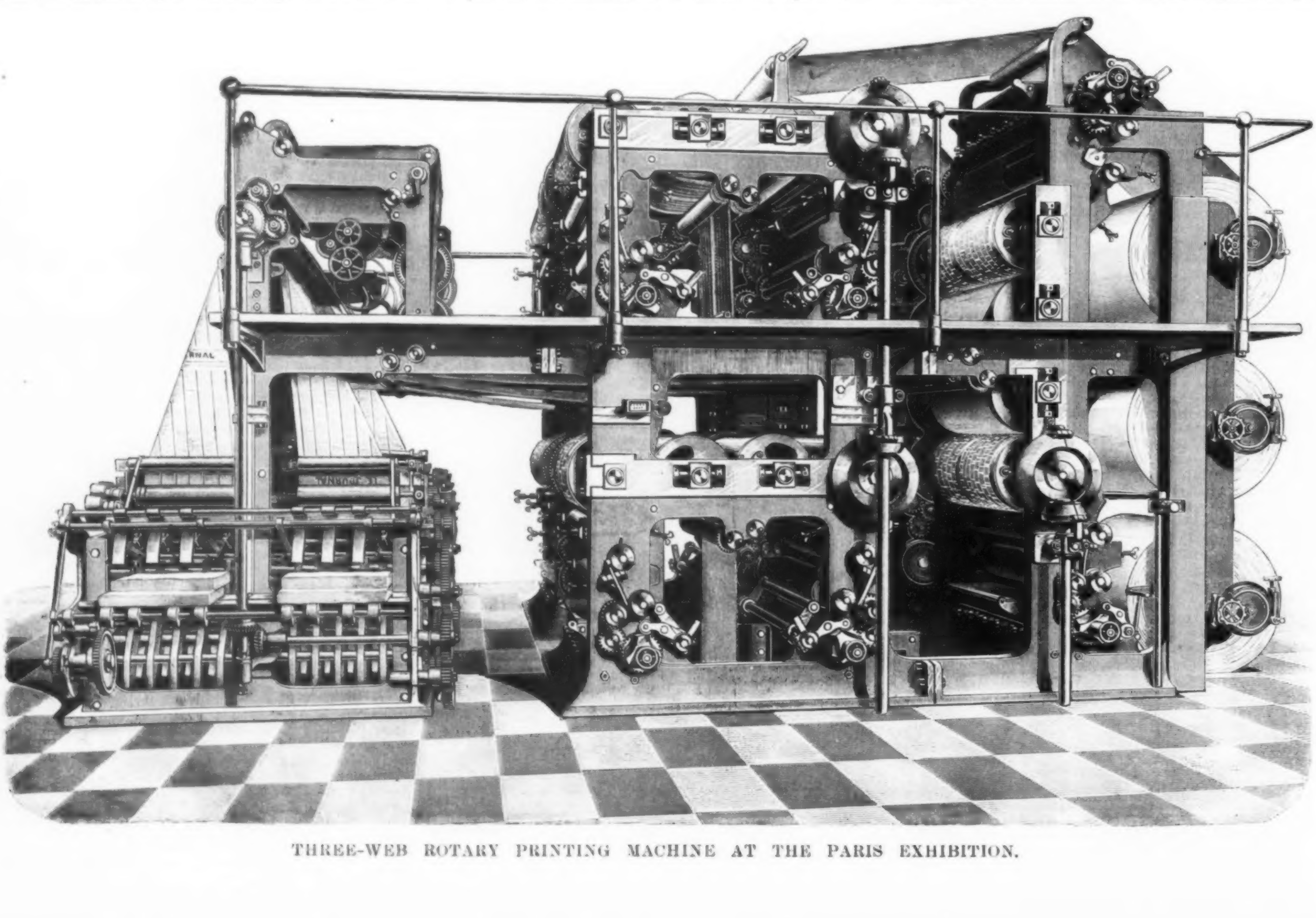
It may be objected that the velocity of the shutter, which plays a great rôle in the calculation, may vary and falsify the result; but it would be a very simple matter to control such velocity as often as desirable by making a negative of a movable object having an invariable speed, say a needle made to effect one revolution per second by a well regulated clockwork movement. A dial placed behind and graduated in centimeters would thus give an easy verification. It will be remarked that photography offers the advantage of facilitating the ulterior discovery of a carriage that is trying to escape prosecution by flight; and this responds precisely to an objection that is made to this method, viz., that of necessitating a measurement made upon the carriage itself. It is clear that if such measurement is rendered impossible as a consequence of the disappearance of the vehicle, any attempt to obtain evidence is useless, since it is impossible to know the person against whom an action is to be taken.

From a practical point of view there is nothing to prevent such an apparatus from being adopted by the Prefecture of Police and from being placed by the latter in the hands of such of its agents as are charged with the surveillance of automobiles. The expense would be trifling.—For the above particulars and the engraving we are indebted to La Nature.

PRINTING MACHINES AT THE PARIS EXHIBITION.

ONE of the most important exhibits of printing machinery at the recent Exhibition was that of M. J. Derriey, of Paris. We illustrate one of the machines that was shown, and give a brief description of it. The collection included a stop-cylinder machine, with American inking arrangement and automatic flier; this machine was designed for ordinary job and book work. Its working speed was 1,400 double-royal sheets per hour, and its special features were compactness and facility of access to the forms. There was a second stop-cylinder machine of heavier construction, and with a more complete inking system; the inking rollers were driven by gearing.

A larger machine was a Derriey rotary, constructed especially for high-class illustrated work. Machines of this class have been supplied by the makers to various establishments in this country, among others to Messrs. Waterlow & Sons and Messrs. Lever Brothers. The machines are high speed, and can be worked as perfecting or single side printing machines. The machine exhibited by M. J. Derriey in action is arranged to double the delivery of work printed on one side only. To effect this the machine is so arranged as to be capable of being run as two independent machines, or as one coupled, for per-



THREE-WEB ROTARY PRINTING MACHINE AT THE PARIS EXHIBITION.

fecting work; the necessary work for connecting or disconnecting can be completed in a few minutes. This special class of machine was the outcome of a competition instituted by the National Printing Department of France, by which the design of M. Derriey was accepted. It is used for printing telegraph forms, official wrappers—anything, in short, for which there is a large and continuous government demand. Its relatively high speed and excellent inking arrangement qualify this machine for general printing and illustrated work. Another machine exhibited was a new type of rotary web machine, made for printing 4 or 6-page papers with a single roll, but other and larger machines are in use printing 8-page papers with a single roll. The cylinders and all other parts of the machine are very accessible, and it is claimed by the constructors that "making ready" does not take half so long as any other type of machine—French, English, or American. The guaranteed rate is from 20,000 to 24,000 copies an hour, according to the number of pages. The copies are delivered cut, inset, and pasted, and in counted quire packets. The annexed illustration shows a triple web rotary machine for newspapers of from 6 to 12 pages; its guaranteed speed is 40,000 copies an hour for 4 to 6 pages; 30,000 copies for 8 pages; and 20,000 copies for 10 to 12 pages, each being delivered folded, inset, and pasted. Another and somewhat similar machine, adapted for color printing, is being made by the same firm, but to do somewhat higher-class work, with a smaller delivery. In the magnificent display made by M. J. Derriey were several other machines, one for printing a fixed size, and another for taking any size up to the maximum. An ingenious arrangement of pneumatic feed is a special feature of this machine. Apart from the exhibit of M. J. Derriey, and those of Marinoni, and a fine German machine, there was but little of novelty in the printing machinery shown in the Exhibition. A passing reference may, however, be made to the ingenious little American machine known as the Johnson die press, and controlled by the Linotype Company in England. This press replaces the slow hand method of printing visiting cards and other small similar objects; the inking, wiping, and feed, are automatic, and the delivery is comparatively rapid.—Engineering.

THE MAGNIN PYROGRAPH.

FEW problems of a mechanical order have given rise to so many researches and to a larger number of inventions than that of assuring safety in railway travel. It is but just also to state that upon no field of research is seen a more abundant crop of foolish, strange, or simply senseless solutions. The reason is that the problem appears at first sight puerile to the laity, and by laity we mean investigators who are ignorant of the technical conditions, so disconcerting in their multiplicity, that are always presented when considering the simplest modification of the locomotive, the track, the operation of the signals, etc. This complication is such that it may be affirmed that a truly practical invention, well conceived and at once utilizable, can emanate only from some one who has made railways his specialty, and the sole and constant field of his studies and researches. A few exceptions would only go to confirm this rule. If we endeavor to account for the intellectual work that culminates in so large a number of ridiculous or valueless creations, we shall find that the locomotive, a huge machine moving along at incredible speed upon an invariable track, composes a mass in motion capable of performing powerful work, and hence the very simple (!) problem is reduced to the proposition to deduct a little of this power, on the passing by of a signal, in order to actuate a warning mechanism placed in sight or hearing of the engineer.

Now, in reality, there is no problem more delicate, and the innumerable failures of the apparatus that appear to be the best combined have superabundantly demonstrated how many difficulties there are in the way of the realization of this desideratum.

In the first place, by its speed and mass, a train under way is the worst of transmitters of motion, seeing that it acts by percussion, a terrific shock destroying all resistance. We invite discouraged inventors to meditate upon the lesson given upon the passage of an express train by the wild oats growing at hazard between the rails! Bent at the passage of the storm of metal, and lightly touched by the axles, they gently lift their heads again and continue to live after the train has passed. The reason is that these frail plants have opposed no resistance to the huge mass in motion. In place of these plants, let us suppose a stick or an iron rod firmly fixed in the ground, and compare the results. Another thing; when a locomotive hauling cars is moving upon a track, the ordinary individual sees only material masses of precise forms connected and gliding over the rails, and the whole represents to him all the pieces interested.

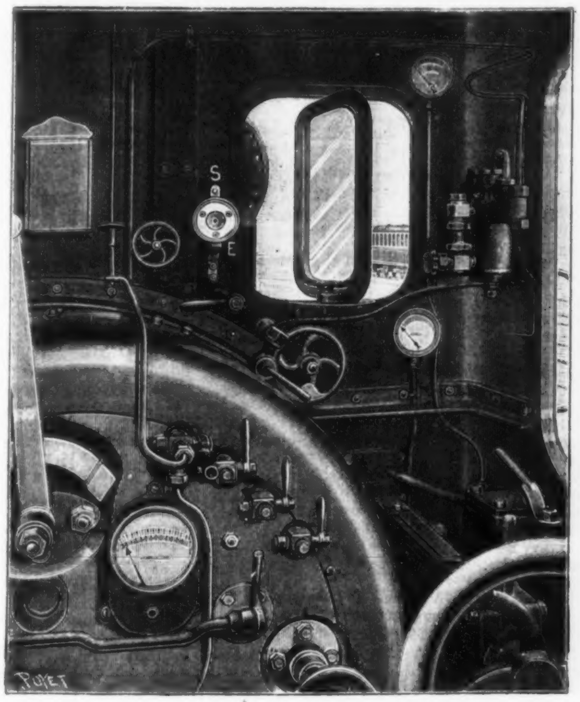


FIG. 2.—THE PYROGRAPH UPON A LOCOMOTIVE.

E, registering apparatus; *S*, alarm whistle.

To the eyes of the initiated, the professional man, the railway engineer, the thing is entirely different. The locomotive and cars are inscribed in a definite geometrical figure in which all the pieces that compose a train take their place. Such invariable and geometrical figure is called the "gage." The track also has its gage, in which are likewise inscribed the numerous stationary objects that a train may meet with on its route; and it will be easily understood that it is very necessary that these two gages shall not penetrate each other.

Now, all, or almost all, inventions of signals for the engineer are reduced to one part that "infallibly" puts the two gages in communication, and that, too, according to inventors, without a miss and without a break of any kind. And this is not any easy thing when we consider that a train that has been started does not move like a pair of curtains upon a rod, and that it is necessary to contend with racing and rocking motions, the inclinations of the track and the vibrations that modify the relations of the two gages at every moment.

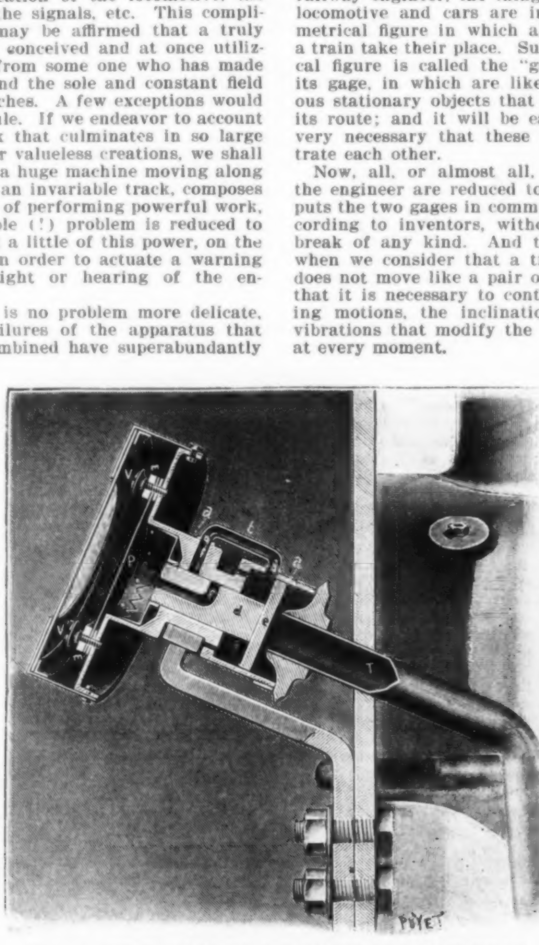


FIG. 1.—THE MAGNIN PYROGRAPH—INTERNAL SECTION.

From what precedes, however, it should not be concluded that no interesting modification has been effected. An advance has been made toward a solution of the question, and the best elaborated systems are those that have been inspired by the "wild oats," in requiring only a minimum of stress from the mass of the locomotive, a scarcely touched pedal and an electric contact. In this way it has been possible to limit the number of misses; but, despite all, it is impossible at present to assert that any of these systems is infallible, and the continuous vigilance of the engineer still remains one of the most important factors of safety upon the railway.

Under the reserve of these observations, it is interesting to examine certain of the solutions proposed, and it is in such a spirit that we present to our readers the invention of the brothers Magnin, who have conceived the idea of utilizing the explosion of a torpedo which violently displaces the air in its immediate vicinity and causes a durable registering of the detonation under the eyes of the engineer. In order to obtain such a result, a tube, *T* (Fig. 1) is so placed that its extremity, which forms a bell, shall terminate near the wheel that crushes the torpedo. The other extremity of the tube is continued by a cylindrical chamber, *a*, the internal surface of which is carefully polished so as to permit of the easy sliding of a cylindrical traveler, *d*. The front part of the latter presents a box, *c*, the circumference of which is cut into very thin teeth having sharp edges. The ends of these teeth, in the normal position of the apparatus, are situated a few fractions of an inch from a sheet of white paper, *p*, stretched over a rectangular frame, *m m'*, held in place by screws, *vv*, upon a frame integrally formed with the chamber, *a*. At determinate points, *n* and *n'*, the chamber, *a*, is provided with apertures that are connected by a tube, *t*. The traveler, *d*, is provided with a channel, *f*, analogous to the apertures, *n* and *n'*. Finally, the chamber, *a*, is provided at its lower part with a groove with which engages and in which slides a guide-feather, *g*, of the traveler, *d*.

Let us now see how the apparatus operates. At the instant at which the front wheel of the engine causes the detonation of the torpedo placed upon the rail, the latter and the tread and flange of the wheel offer an obstacle to the expansion of the gases of explosion, the greater portion of which, directed forward and to the external side of the track, is received by the bell of the tube, *T*. The pressure received through the opening of the tube is transmitted by the air contained therein to the posterior surface, *e*, of the traveler, *d*, which is thrust forward until the breech, *e*, abuts against the bottom of its housing in the chamber, *a*. This motion of the traveler causes the teeth of the box to pass through the taut sheet of paper, *p*; and, since the forward motion is of an extent greater than the length of the teeth, the central part of the paper is completely cut out into a disk of the same diameter as the box. This little disk constitutes a visible signal; but, in addition, its natural fall uncovers the box, *c*, the bottom of which is painted red, and which the eye of the engineer then perceives.

Since a natural fall of the disk cannot take place invariably, for various accidental reasons, there is an arrangement provided for permitting it to be driven from in front of the red bottom of the box, *c*.

After the traveler has moved over the space necessary for the cutting of the paper, the air compressed in the tube, *T*, passes through the apertures, *n* and *n'*, of the tube, *t* and *f*, of the traveler (which has come opposite *f'* of the chamber, *a*) and passes into the box, *c*, from which it ejects the disk of paper, thus causing the red bottom to appear.

In addition to this apparatus, the inventors have adapted to the locomotive a system of levers, one arm of which, in touching the torpedo, produces the opening of the air cock of the brake and actuates an alarm whistle. Such addition enters into the category of apparatus that operate through shock or through a well assured contact, and does not present the ingenuity of the pyrograph. Fig. 2 shows, at *E*, the registering apparatus, and, at *S*, the alarm whistle.—For the above particulars, and the engravings, we are indebted to La Nature.

THE EDUCATION OF A SHIPBUILDER.

Prof. J. H. Biles delivered a lecture on this subject on Saturday, January 12, before the Glasgow and West of Scotland Technical College Scientific Society, says The Practical Engineer. After some introductory remarks on the real meaning of the words "education" and "shipbuilder," the professor said:

SHIPBUILDING PROBLEMS.

One of the first things which go to make up the education of a shipbuilder is that nothing should go into a ship which cannot earn a dividend. Let us apply this to a case which all can understand. Suppose a vessel is classed at Lloyd's or the British Corporation, and a shipbuilder or shipowner desires to double the sheer strake—that is, to make the top strake of plating in a ship double the thickness prescribed at Lloyd's. This can only be done by an additional first cost, and frequently by a reduced earning power. The desirability of fitting such an extra amount of strength must depend upon whether at some time in the vessel's life she will be so strained as to necessitate the spending upon her of more than the sum represented by the first cost of the extra plate, the loss of earning power up to the time that she is strained, and the interest on these two sums. Can such a problem receive an exact solution? If it can, obviously the power to solve such a problem is a very necessary item in the education of a shipbuilder. This, however, is a question which affects the design of a ship, and depends primarily upon a knowledge of the strength which is required in a ship to resist the action of the forces which are brought to bear upon her by the sea. This subject is a large one, and involves a knowledge of the principles of and the observations upon the strength of materials, and also of the best method of combining the parts of a structure so as to give the necessary resistance to the forces that act upon it. It also involves a knowledge of the forces which bring stresses upon a ship and the distribution of these stresses throughout a ship. This simple instance of the double-sheer strake is one of hundreds in which fuller knowledge means more earnings, because there is a loss in first cost, and in money-earning power in every unnecessary ton of material put into a ship. Of course, it is very easy to be safe for the moment, and to put more rather than less material into a ship. This is probably a more general practice than would usually be admitted to be the case, and it is difficult to see how it can be otherwise while such organizations as classification societies fix the minimum of scantlings for every part of the ship. Under such a system no one can attempt to make lighter any part of a ship which he thinks or knows is too strong, and the education necessary to determine practically the actual strength of a ship by reducing the unnecessarily strong parts to the sufficiently strong amount is in most cases unattainable. Let us turn to another instance, in which the money earning may be affected by the knowledge of the shipbuilder. Every steamer requires a certain power to propel her at her desired speed, and this power is largely determined by the form of the ship. Any change in form which (while fulfilling all the necessary conditions) admits of a reduced power necessarily increases the earning power of a ship and also her first cost. Every horse power saved means about four tons of coal per year, and as this coal is not only not bought, but not carried, it means an ability to carry four tons more cargo per year. Most of the vessels afloat have horse power from 2,000 to 4,000, so that even one per cent of this means an appreciable increase to the money-earning power of the ship. There is also the saving on first cost to be taken into account.

ECONOMIC PRODUCTION.

What are the elements of production in a shipbuilding business? First let us consider what is to be produced, and then let us consider the economical ways of producing it. A ship is a steel structure which must be capable of crossing the seas in all weathers. If she is a mercantile vessel she must do so with as great a revenue-paying cargo as possible and with a minimum of expense for transportation. In the cost of transportation must be included interest on first cost, depreciation in value of ship, and insurance of value against loss. Hence first cost enters into the expense of running a vessel. If the vessel is a non-revenue-earning ship, such as a warship, first cost is almost the only consideration with a shipbuilder, but he has always to give his attention to the question of how the work of running a ship can be done with the least possible expense, both for actual working expenses and for cost of repair and maintenance. The steel structure of the ship is made from material which is rolled in the steel works, its first cost being paid by the shipbuilder, but only in a small degree is he able to affect the cost of production of the steel. He may, by so modifying his structure, make the work of the steel manufacturer more or less costly. For instance, he may, in the design of his structure, introduce sections whose form is difficult to roll. He should, therefore, be familiar with the processes of steel manufacture, though he may not be necessarily an expert steel maker. In a warship design a very full knowledge of the capabilities of steel manufacture, especially in the armor-producing department, is necessary. It is, however, in the matter of fixing the sizes and arrangement of the parts of the steel structure that a shipbuilder is most likely to influence the cost of his productions. The structure has to be treated as a whole. Frequently in a structure it happens that material which is meant for one purpose may serve other purposes. Take, for example, the case of a transverse water-tight bulkhead. Generally, it is put in to subdivide the vessel, so that in case of damage by collision or otherwise the amount of water which enters the ship shall be limited. This purpose is one which rarely, if ever, the bulkhead fulfills, because the ship seldom gets flooded by collision or otherwise. In some ships, for instance sailing ships, there are no such bulkheads except perhaps one forward. In others the number is great, being as large as 17 in some of our large Atlantic liners. The number of bulkheads is determined by the consideration of the amount of flooding which is desired to be provided against, the amount being one which does not endanger the safety of the vessel. But these water-tight bulkheads, though they may never be called upon to fulfill their original intention, can be, and generally are, made use of to add to the structural strength of the vessel. They form one of the greatest means of resistance to change of form when a vessel is rolling, and one would naturally expect that any vessels which have a large number of bulkheads, preventing change of form when rolling, would be made less strong in other parts of the vessel in consequence of the increased number of bulkheads. The educated shipbuilder should know how and where to make such allowance. This is only one instance of many of the same kind where material is introduced in the structure for one purpose, but it may serve more than one, and thereby cause a reduction to be made in other parts of the structure where material has been rendered unnecessary or excessive by the introduction of some for another purpose in another way. At one time ships had only wooden decks, even in iron vessels. With the increase of size of the vessel it became desirable and necessary to have complete iron decks. The object of the wooden deck—the formation of a platform to walk upon—can be fulfilled by the iron deck the moment that deck is made a complete one. The iron deck, when complete, fulfilled the double purpose of giving the necessary strength to the structure and forming the platform which had previously been formed by a wooden deck, and the weight of the wooden deck ought to be saved. In the design of the structure of a ship the shipbuilder must be able to estimate or judge the effect upon the strength of the structure of variations in arrangement from ship to ship, so that he may be able to take advantage of changes which have been made for other than strength purposes, but which add to the strength, in order to reduce the weight of his structure, always, of course, retaining the strength necessary for the purpose of the ship. The design of structure also naturally affects the cost of putting the structure together, which structure, if made in too many pieces, will cause the work of connecting these parts to add to the cost of the vessel; while if it is made in too few pieces the parts cannot be economically handled or will involve the use of plant of too expensive a nature for profitable production. Experience often teaches the sizes of different parts of structure, as far as these two last-named considerations go, but a knowledge of the limitations of the steel manufacturers in regard to sizes is a necessary part of a shipbuilder's education, as well as a knowledge of the limitations of shipyard plants. Here we find two things clashing with each other, each very important in the economical production of a ship. On the one hand, the extra cost of workmanship due to having to get a larger number of parts together; on the other hand, the extra cost of machinery or plant (or rather the interest upon and depreciation of the extra cost of the plant) to enable larger pieces to be handled. This is a matter for estimating, but there is evidently a strong inducement to reduce the cost of workmanship by the adoption of machinery, when one remembers what has been already stated that one man's wages is equivalent to the interest on £1,000 of capital. It is also to be remarked that, in addition to the saving on the cost of workmanship, there is generally an increased output, due to the reduced time which the work takes to do. Take the case of outside plating. Twenty years ago 12 feet by 4 feet was about the normal maximum size of plating. Such a plate would weigh a little more than five-eighths of a ton, and it could be transported on a light barrow and hoisted by plating tackle by the men who were necessary to mark it and punch it. Plates are not uncommon now of more than double this length, and of breadth nearly half as much again, and of a weight of quite three times. The number of rivets per ton weight of plate is one-fourth less in the large plate than in the small one. But the adoption of such plates involves power cranes, iron railways, and much heavier plant generally. Instead, however, of being able to turn out a ton of shipbuilding, we should now be able with the same amount of workmanship and this improved plant to turn out more than one and one-third tons, a gain of 33 per cent in output. It is evident that there will be some point at which increase of plant cannot be economically adopted, or where increase of plant cannot be associated with increase of size of pieces which go to make up the structure because of the limitations which the steel manufacturer has placed upon him.

KNOWLEDGE OF STRUCTURE.

Here we see, then, the education of the shipbuilder necessarily includes knowledge of the use of machinery, both as it exists and as it may be improved, as well as the knowledge of the cost of workmanship under existing and under the improved conditions. The same kind of considerations apply to a great many parts of the structure and equipment of the ship. There is also the simpler question of the direct displacement of manual labor by machine labor to do the same work, because of its greater rapidity and its less cost. Mechanical drilling, caulking, riveting, are objects for the application of the results of education in mechanical engineering. Not only is it necessary for the mechanical engineer to know something of the structure of ships, in order that he should construct tools for improved economy and efficiency in the manufacture, but the shipbuilder has to make himself familiar with the methods of the mechanical engineer in order that he may suggest to him the kind of tool that he wants and the method of overcoming the difficulty that he has to face. He has to be familiar, in other words, with the theory and practice of machines. A ship's structure cannot be made without machines. The type of the machine is determined by the structure, and the structure depends upon the machines that are to make it, so that these two things act and react upon each other, and the shipbuilder has to be familiar with the science of the arrangement of the ship's structure so that it shall do the work that it is intended to do, and he has to be familiar with the science of machinery which is to make that structure. The cost of production depends upon the design of the structure and upon the method of putting it together. The design is moulded by the shipbuilder to fulfill the two requirements: (1) What the structure has to do, and (2) how it is to be put together. Of course, there are a great many things that go to make up the cost of a ship which do not contribute to the main structural strength. In fact, many of them will involve a greater strength of structure than would be necessary without them. For instance, the main engines and boilers add considerably to the weight of a ship, and require a great amount of extra structure to support them, and the engines when not properly balanced cause considerable vibration in a ship and seriously try the workmanship. It goes without saying that a shipbuilder must be acquainted with the general arrangements of machinery. Of course, many shipbuilders are marine engineers as well. There is no reason why this practice should not become general. There is nothing in the scope of the science of naval architecture or marine engineering which should prevent a man from having a fair knowledge of both. The machinery and the hull are parts of a great whole, each adapted for the use of the other—the machinery to drive the ship, and the ship to carry the machinery. In high-speed vessels the machinery is the most important component part of the structure, but in vessels that are usually called "tramps" its importance is less. It does not tend to embarrass a shipbuilder so much as in highly-powered vessels, where frequently it is so all-pervading that the boilers bulge the bottom out, while the funnels reach into the clouds. The coal bunkers extend from the forepeak to the stuffing-box bulkhead, and the engines fasten themselves on the backbone of the ship, and waggle the two ends about their revolving cranks. The ubiquitous moisture escaping from the steam joints of the machinery corrodes more or less all parts of a ship, so we see that it is impossible for a shipbuilder to construct a high-speed steamer without a very intimate knowledge of marine engineering. The prevention of corrosion is one of the subjects in which the shipbuilder's knowledge of chemistry may serve him in good stead. Whether red lead, iron oxide, or bitumastic paint best serves the purpose of preserving the inside of a steel ship is a subject which may well engage the attention and observing powers of a shipbuilder with a knowledge of chemistry and the chemist who takes an interest in a ship. If no provision had to be made for corrosion many parts of the structure might initially be made lighter, with the consequent economy in first cost and increased weight carrying which follow. On the other hand, possibly too little money has been spent in examination and opening up the internal part of the steel structure after the ship has come into possession of the shipowner. A constant watching of the part liable to corrosion and a frequent repairing may in many cases be consistent with a reduced thickness of various parts of the ship.

EXPERIMENTAL TANKS.

I have already touched upon the question of gain in money-earning capability due to reducing the engine power necessary to obtain a required speed. This, we know, depends partly on displacement or weight of ship. The latter, for a given weight carried, depends upon what we have already discussed—weight of structure. The former depends upon the knowledge of the shipbuilder of the subject of resistance of ships. This knowledge may be gained by experience or experiments in a tank, or it may be gained by experience (which is also experimental) in full-sized ships, or it may be by both. Carefully conducted progressive trials upon the measured mile related to the carefully-recorded results of sea voyages form the basis for determining the power required to propel a required ship at a chosen speed. They also serve the purpose of carrying out experiments which thought and observation suggest with a view to improving efficiency, or, in other words, reducing horse power and increasing money-earning capability. Wrapped up in this subject of resistance, due to form, is that equally subtle one of the efficiency of the propeller. The difference between economic success and economic failure has often been entirely due to the propeller. It may not be uninteresting to relate to you what happened at the respective trial trips of two sister vessels which were, in their day, the holders of the speed records in their particular line. One was tried with a set of propellers of the orthodox cast steel, blunt-edged, thick-rooted, rough type of the 1870-80 period. A speed of something under 20 knots was obtained in this vessel—not a bad speed in those days, but not sufficient to satisfy the desires of those interested in the ship. The second vessel was supplied with a much more genteel propeller—one of the up-to-date type—brass (brazen, one might almost call it), sharp, keen, smooth, elastic. On the trial the speed which had been obtained with difficulty in the first vessel was exceeded by two knots with the greatest ease in the second vessel. The power lost somewhere in the first vessel was 20 per cent of the total power. This is not a small economy, but one which would make all the difference between success and failure. It is needless to say that the propellers of the first vessel were very promptly changed, and the two vessels carried out fully the original intentions of their projectors. I need hardly say much about the many precautions which the education of a shipbuilder prompts him to take to insure that the vessel produced shall be what he intends her to be. He carefully studies the subject of stability, not that he attaches a direct money value to so much stability, but in order that the vessel shall not give trouble and annoyance to those who have to handle her by being short of stability, nor shall she get a bad name as a seaboat because she has too much stability. Her reputation is that of her builder's, and he is careful to avoid any reflection being cast upon either. He also carefully studies how he can arrange his ship so that the omniscient government official shall not have reason to find fault, and so that no more space than is absolutely necessary shall be measured for tonnage, because it is upon this tonnage the shipowner is taxed, and in this respect he and the shipowner are hand-in-glove. Some very well educated shipbuilders have even been known to make a special study of the subject of reduction of net tonnage with a view to saving the due payment of rates, but it is not desirable to appear to be too studious in this matter, or one is apt to be open to the suspicion of a slight leaning in the direction of what has been called "tonnage cheating."

POISONOUS PLANTS WHICH GROW WITHIN OUR BODIES, AND HOW TO CONTEND AGAINST THEM.*

IT has now become a matter of common knowledge that many of our most dreaded diseases are caused by bacteria, or "germs," as they are popularly designated. It is the object of this lecture to direct attention to these bodies as plants, to consider their poisonous action and our methods of defense against them.

As plants, they agree fairly well with various members of the Fungi, with which they are commonly associated in classification. They obtain their food for the most part in the same general manner, by tearing down organic compounds, and making use of the simpler chemical substances thus produced, which they take in by a simple process of absorption over the entire body-surface. They are, like other plants, of cellular structure, though of but a single cell. They are noted for their small size, the united length of many thousands being required to measure an inch. A great many of them, like other lowly organized plants, possess the power of locomotion, and travel about by means of cilia. They show the same variation in healthfulness and luxuriance, according to the special suitability of their growing medium or environment, that other plants do in regard to their soil, climate and exposure.

Though certain forms are grown for utility, those which cause consumption, diphtheria, typhoid and kindred diseases, are studied chiefly to discover what conditions will destroy them, or at least tend to inhibit their development or physiological activity, or counteract the injurious effects of the latter.

Their dependence upon special conditions, or upon certain soils, as we might well express it, is evident in the ability of certain bacteria to grow, at least with their customary form and vigor, only in certain organs of the body. Even this power is limited to certain individuals, for we often find them in healthy persons, alive but unable to grow or cause the appearance of their particular diseases. It is even more significant, and far more important, that in the same body the germs will be able to thrive at one time but not at another. It is also notable that in the case of some disease-producing bacteria, the luxuriance with which they develop, and even more particularly the violence of the diseases which they produce, depend in a high degree upon their association with other species. Thus, the species which produces tetanus, or lock-jaw, cannot live where there is a free access of fresh air or oxygen; but if it can associate with itself another species, which does consume oxygen, the two can thrive together.

Upon the other hand, there are cases in which such association is adverse to the welfare of the germs. This fact has been utilized by introducing the plants of erysipelas to the systems of those suffering from sarcoma, a disease presenting many similarities to cancer. The latter has been entirely cured in some cases, greatly benefited in many others.

It should be noted also that to a greater extent than any other class of plants, perhaps, bacteria possess the power of adapting themselves to adverse conditions. After fully accustoming themselves to a new order of things, they may even grow and develop with all the vigor natural to their previous condition, though usually they do not thus learn to thrive, but gradually lose their vitality or virulence, which may sometimes be again restored by transplanting them to a favorite soil. Thus the lockjaw bacillus, much as it dislikes oxygen, can come to live in the lungs themselves, though none of its characteristic poison can be produced there.

These peculiar properties of bacteria have, of course, to be seriously reckoned with in the selection of all methods for combating them and their effects. They often increase greatly the difficulties under which such action is pursued, though modern science has sometimes found it possible to utilize these very peculiarities in devising protective measures.

In reproduction, bacteria depend chiefly upon the method of simple body-division, and have thus come to be generally known as "fission" plants. The new individuals may at once separate to lead independent lives, or they may remain in the pair, or many connected pairs, resulting from the dividing process. They differ from other plants in the enormous rapidity with which this process is performed. A few minutes usually suffices for the perfect development and maturity of the progeny. It thus becomes apparent how in such diseases as anthrax, where these plants develop freely in the blood, the latter can in some places become within a few days almost a solid mass, the blood vessels completely dammed, and circulation in that part entirely suspended.

Many species reproduce also by spores. Not only are such species enabled to retain their powers of reproduction, and, therefore, of disease distribution, for very prolonged periods, but they are much better enabled to resist adverse conditions.

The production of poisons by these plants is most easily demonstrated. It has already been shown that if the germs taken directly from the body of one suffering from a given disease be introduced into the body of another, the diease may be communicated to him; also that the germs can be propagated in some extraneous medium, as bouillon, for an indefinite period, and then be similarly used to inoculate another with their disease. In both these cases, the party to whom the disease is communicated can become the source for another inoculation, and so on, showing the successive reproduction and development of the plants in the bodies of the different persons. If, now, a portion of the liquid containing these germs be heated to a temperature known to be fatal to the latter, this power for the continued transmission of the disease is lost, as is clearly proven by inoculating an animal with the substance and failing to secure any further transmission of the disease from the substance of his body. No living germs, therefore, were conveyed to him in the inoculated substance. Yet, under these circumstances we find that he will exhibit the subjective symptoms of the disease, so severely sometimes as to promptly cause his death. From this observation there is but one rational conclusion, namely, that the germs, while growing in the liquid, gave out to it their produced poison, which poison, injected in solution into the animal's body, poisoned it, just as it would have done had it been produced within that animal's body by germs existing there. So strong, it is said, will this poison solution sometimes become, where diphtheria germs are cultivated, that a single drop of it will kill a large and healthy horse.

The extent to which the poison is produced under different conditions, or the "virulence" of the germs, is extremely variable. This variation is manifest in different epidemics and in different cases of the same epidemic.

Two quite distinct methods exist for the production of the poisons. One is the same as that followed by ordinary poisonous plants, like the toad-stool, or the aconite, belladonna or strychnine plants. In each of these the poison results as a waste-product from the nutritive processes going on within the plant-body, so that the substance of the poison has previously belonged to the substance of the plant-body. While this poison can be of service to the plant as a protection, yet it cannot be allowed to accumulate indefinitely. The aconite plant gets rid of it by storage in its tuber, which then decays in the soil after producing the plant of the following year. The belladonna plant stores most of it in the leaves, which fall and decay, while the strychnine plant does the same with its seeds. In the case of bacterial plants growing within our bodies, these poisons can be discarded from the plant-bodies only by excretion directly into our blood, and this, we have already seen, is proved by observed effects.

The other method of poison-production is that by which the bacteria tear apart the organic substances of the tissues or fluids which surround them, extracting the very small portion which they can use, and leaving the residue, or part of it, in the form of a poisonous body. So far as the result is concerned, this method does not differ from the other, though it explains the extremely destructive nature of these organisms in disease.

Bearing in mind the facts and conditions here discussed in relation to the development, reproduction and poison-production of disease-producing bacteria, we are prepared to understand our methods of contending against them. Some of the deductions are sufficiently plain, while others are most occult.

It is of prime importance to know the methods by which the different germs are ordinarily introduced into the system. Some, as those of typhoid and cholera, are practically incapable of introduction except by the medium of the mouth. This does not mean at all that they must be present in our food or drink, as it is perfectly easy, and indeed common, for children, after handling their shoes or other polluted objects, to place the fingers in the mouth. Some, like the dreaded anthrax, are practically unable to inoculate us by the bodies of their germs except by direct contact, though it is possible for their spores to gain entrance through the lungs, by inhalation. Those of pneumonia and influenza must get into the air passages, in most cases, presumably by inhalation. Diphtheria germs can grow readily in the eye and upon abraded parts of the body-surface, where contact is easy. Tetanus must enter the system by a bruised or incised surface. Tubercular germs can be lodged by inhalation, but, in spite of a tendency to become destroyed by the action of the stomach juices, they very frequently find entrance in our food and drink.

Our first and simplest method of defense against these diseases is manifestly the avoidance of infection and contagion. A perfect accomplishment of this result is well-nigh impossible, but since the outcome of an attack depends largely upon the number of germs making it, careful protection is at all times to be recommended.

Successful protection involves special methods in the case of each germ, as their habits and offensive and defensive powers differ among themselves. Some require oxygen, others are destroyed by it, while others are similarly sensitive to sunlight, and again certain temperatures are fatal to certain species.

Closely connected with this subject, and constituting one of the most important departments of hygiene, is that of methods of disinfection or sterilization, a process by which all germs and spores capable of producing inoculation are destroyed in or upon objects which must be handled or consumed. The details of these processes are discussed in simple manner in many works, where they should be sought by every one interested in the welfare of the community, as well as in personal safety. Cold, even so low a temperature as 300 deg. below zero, does little more than temporarily check their activity, while a degree of heat, readily secured by ordinary methods, and definitely fixed for each species, is fatal.

By far the most important precaution in our power is the preservation of good general health and a high state of vitality. The foreign germs are never left by our body-cells to make an uncontested invasion. The battles between our cells and the foreigners have been actually photographed, showing defeat now upon one side, then upon the other. Manifestly, increased vitality means increased safety, and, of more importance to most of us, increased vitality and higher powers of resistance for our posterity.

Assuming that all these precautions fail, and that we are either stricken by disease or ready to become so if exposed, what shall we do to avoid infection; or, if infected, to produce a cure? Success in answering this question has been only partially attained; yet this measure of success represents, perhaps, the most remarkable of all achievements in applied science.

Up to the present, we are practically without mineral or vegetable drugs capable of destroying these disease-producing plants within the body. Many substances are fatal to them, but only when concentrated to a degree dangerous to our own tissues. But this problem, too difficult for the chemist or the medical botanist, is solved by natural forces working within us. The existence of such a power is proven by the fact that we recover from these diseases, even after being weakened by them, and although we were unable to resist them at first, when we were stronger. It is further proved by our immunity against another attack, at least for a long period, after recovery. These well-known facts are understood when we learn that our own body-cells possess the power, under the stimulus of the germ's presence and of its poison, to manufacture and add to the blood substances antidotal to the germ poison, or fatal to the germ itself, or both. To these substances, because we call the germ poisons toxins, the term *antitoxins* has been applied. The gradual change thus effected in the composition of the blood is indicated by the gradual disappearance of the germs from the system as the disease progresses. It is also seen in the effects of mixing some of a convalescent's blood with a solution containing living and healthy germs, which are at once killed. Again, it is seen in the effects upon the disease of introducing to the body of a patient blood taken from one who has recovered, when there is more or less of an immediate tendency to counteract the poison of the disease. Or, if the individual has not yet contracted the disease, he can be prevented from doing so upon inoculation of the poisonous germs, if this blood from a convalescent be at the same time introduced. We therefore say that the convalescent has become immune, and that an immunizing power has been imparted to his body fluid, and that by the injection of this fluid a similar immunity can be conferred upon another.

It being manifestly impracticable to secure a sufficient quantity of such immunizing fluid from the bodies of convalescent human beings, recourse has been had to the lower animals, the horse being chiefly employed. The methods, now that they have been successfully worked out, appear simple enough. We dare not inoculate the animal with the disease germs, lest the disease thus imparted to him become uncontrollable, but we can inject into his blood the poison imparted by the living germs to a solution in which they have grown, but in which they have been destroyed, or from which they have been filtered out. Only a very small amount can be safely introduced at first, but, as the system of the animal manufactures and stores its antidotal quantity of the antitoxin, larger and larger amounts of the poison are introduced, until sufficient to have killed many untreated horses can be safely injected at one time. At length, the animal becomes proof against any ordinary amount of the poison. His blood is now drawn, and its watery portion separated to be sold as commercial antitoxin. It is, in fact, a mere solution of the antitoxic substance, and its strength can be readily fixed by testing its power to counteract solutions of toxin of known strength.

Although diphtheria is the disease to which attention has been chiefly directed, its average mortality having been reduced more than 50 per cent by this treatment, moderate success has also been attained in lockjaw and some other diseases.

Prevention against smallpox illustrates quite a different principle in defense, namely, that of attenuation. This method depends upon the known facts that certain types of a disease are milder than others, and that this mildness can be artificially produced by pursuing certain methods. Under the application of these methods a mild form of the disease is created, and this disease is then imparted to those whom it is desired to immunize. Under this stimulus, their systems manufacture the required antitoxin, which at once becomes effective in protecting them against a new infection. By this method, smallpox, once the most dreaded of diseases, may now be almost called unusual, considering its rarity among our vast populations.

* Abstract of a public lecture delivered at the New York Botanical Garden, November 10, 1900. By Henry H. Rusby, M.D.—From The Journal of the New York Botanical Garden.

ANCIENT BRIDGES.

THE grandest bridges of the Romans were aqueducts; but after centuries of unrest the noblest conceptions of architecture were realized in the Gothic churches; there was little demand for roads, bridges, and less still of aqueducts. Yet the monks did not build cathedrals and monasteries only. To them we owe the introduction of flat arches. The Romans had preferred semicircular arches, which rarely exceeded 70 feet in span. The founder of the Brothers of the Bridge, St. Bénezét, adopted for his Rhône Bridge of 1178, at Avignon, elliptical arches which had their smaller radius of elevation at the crown instead of at the haunches. The famous Ponte Vecchio at Florence, and the original Augustus Bridge at Dresden, date from the twelfth century. The aqueduct of Spoleto, which looks as if many high and narrow windows had been cut out of a massive wall, is thirteenth-century Gothic work. So is the Devil's Bridge, near Matorell, in the province of Barcelona, Spain, with its apparently reckless pointed arch, which is crowned at its weakest part by a heavy toll-house. The builders, no doubt, understood that the load did not endanger the structure. The springings of this arch are certainly of antique origin, Roman or Carthaginian; an inscription of the year 1760, when the bridge was restored, ascribes the foundation to Hannibal. The span of the stone arch over the Adda, near Trezzo, 236 feet, built under Barnato Visconti, of Milan, in 1370 to 1377 (destroyed again in war time in 1416) has not been surpassed yet. But the piers were in general made unnecessarily heavy, and many a bridge failed because the Roman art of laying concrete foundations between piles had not been re-discovered from Vitruvius' forgotten architecture. French engineers first used caissons, and suggested iron bridges. The first cast-iron bridge, really completed in 1779, however, and still standing, is, according to Engineering, the well-known Coalbrookdale Bridge over the Severn. The arch consists of five ribs. It found many imitations; the Pont des Arts at Paris, with nine openings, and the Southwark Bridge of 1814, with a center arch of 214 feet, and a rise of 24 feet are fine examples. Failures of some of these bridges, however, brought another material to the front—puddled iron—which helped us to suspension bridges. The first specimens: the Tees Bridge at Middleton, of 1741; Telford's Menai Straits Bridge; further, the bridge over the Danube at Budapest, the handsomest of its type probably, supported by two rows of chains on each side, were link bridges. Wire cables came over from the United States about 1815. Some of these bridges collapsed, almost all, e. g., the Sarine Bridge at Fribourg, Switzerland, with a span of 265 meters (870 feet), had to be reinforced.—Public Opinion.

THE MANUFACTURE OF STARCH FROM POTATOES AND CASSAVA.*

By HARVEY W. WILEY, Chief of Division of Chemistry, U. S. Department of Agriculture.

THE total annual production of starch from potatoes in the United States is about 15,500 tons,† of which 6,000 tons are produced in the county of Aroostook, in Maine. The soil partakes of the general nature of drift, containing a considerable proportion of sand and the usual amount of organic matter. It is, therefore, a soil which is peculiarly suited to the growth of potatoes—a soil which does not pack after hard rains nor during periods of drought.

Wisconsin is one of the most important potato-producing States and stands next to Maine in the production of potato starch. In the immediate neighborhood of Stevens Point, in a triangular area of which each side is about 30 miles, there are over 60,000 acres of potatoes grown.

It is shown by the data contained in the analyses of potatoes from German sources, that the use of commercial fertilizers influences the composition of the potato, especially in respect of the quantity of starch it contains. The liberal use of potash not only favors the growth of the potato in regard to yield, but also tends to increase the content of starch which it contains. The German experiments have indicated also that a moderate use of nitrogen tends slightly to increase the content of starch in the potato. An excessive use of nitrogenous fertilizers is to be avoided. Extensive experiments have been made in this direction by some of the agricultural experiment stations of the United States, especially in Maine and Virginia. In Bulletin No. 52 of the Virginia Agricultural Experiment Station the results of the experiments with fertilizers on the composition of the Irish potato are given. The conclusions which were reached at the Virginia station are as follows:

1. That potatoes grown without fertilizers contain the greatest amount of dry matter. The addition of fertilizers tends to diminish the dry matter, and also as the quantity of fertilizer used is increased the amount of dry matter is diminished.

2. Potatoes grown where sulphate of potash is used contain more dry matter than those where muriate is used.

3. The ash is not affected to any very appreciable extent; fertilizers tend slightly to increase it.

4. Very little effect is produced on the starch by either the kind or amount of fertilizers used; their tendency is to increase rather than to diminish it.

5. Potatoes grown with muriate of potash contain less dry matter but slightly more starch than those grown with sulphate of potash.

6. Neither the kind nor amount of fertilizers has any appreciable effect on the percentage of nitrogen, phosphoric acid, and potash contained in potatoes.

7. The percentage of chlorin is considerably increased when muriate of potash is used, and the more muriate used the higher the per cent of chlorin.

The potatoes are planted chiefly during the month of June. This gives ample time for their growth and maturity by the first or the middle of September, when the harvest begins. The planting is done in rows 30 inches apart, by means of a potato dropper. The potatoes which are used for seed are usually cut into two or more pieces before planting. When a fertilizer is employed the drill dropping the potatoes also places the fertilizer in the row. Fertilizers are not used broadcast. By the use of the machine above mentioned the planting takes place with great rapidity, a man and two horses being able to plant from 6 to 8 acres per day.

When the potato tops show above the ground they are first covered lightly by means of a plow. On making their second appearance they receive ordinary cultivation with a horse cultivator and a horse hoe to keep out the weeds and keep the surface of the soil well stirred, the final cultivation being secured by throwing the soil against the plants and forming a ridge. The whole of the cultivation is by means of horse plows and hoes, the hand hoe not being used except in isolated instances. A good team and driver are able to cultivate about 20 acres of potatoes.

The potatoes are harvested with a digger, which enters the ridge far enough to lift the deepest potatoes to the surface. The soil and potatoes together are first received on a platform built in the shape of a grating, the spaces between the bars being large enough to permit the soil to pass through, but holding all the potatoes except those too small for the market. This table is given a shaking motion, so as to break up the soil and have it pass speedily through the bars. Several different kinds of harvesting plows are employed, but the general principles upon which each one is built are as described.

The yield of potatoes varies greatly with the character of the soil and the season. Ninety barrels per acre are considered a satisfactory yield, and this is above the average. The barrel holds $2\frac{1}{2}$ bushels, and the bushel weighs 60 pounds. Ninety barrels of potatoes, therefore, represent a weight of 13,500 pounds per acre. It has been found that in many localities in Aroostook County the yield of potatoes is diminished by the blight. Spraying repeatedly with Bordeaux mixture practically prevents the blight and greatly increases the yield.

Unless the price of marketable potatoes be very low, only the small, injured, or refuse potatoes are sold to the starch factory. Whenever the price of good merchantable potatoes is above 50 cents per barrel the farmers find it more profitable to sell directly to the market. During the time of this investigation good marketable potatoes were selling for $1 a barrel, and the starch factories were paying from 30 cents to 60 cents per barrel for the refuse. It is evident, therefore, that the yield from the weight of potatoes entering the factory is very much smaller than it would be if the whole crop of potatoes were used for starch making. The estimated area planted to potatoes in Maine in 1898 was 45,946 acres; in 1897, 41,769 acres, and in 1896, 49,140 acres. The estimated quantity of starch made during 1898 was 6,000 tons. During the period from September 1 to the latter part of October an average of 60 carloads of potatoes a day had been shipped out of the county.

The number of starch factories in Aroostook County is about 45, and the average cost of a factory complete is approximately $13,000. The average capacity of the factories is about 1,200 bushels of potatoes a day, making a little over 20 barrels of starch of about 600 pounds each. The average yield of commercial starch is 16 per cent of the weight of potatoes employed, the starch holding from 16 to 20 per cent of moisture. This yield is secured only when potatoes of the best grade are used. Poorer potatoes yield only from 6 to 7 pounds per bushel of 60 pounds.

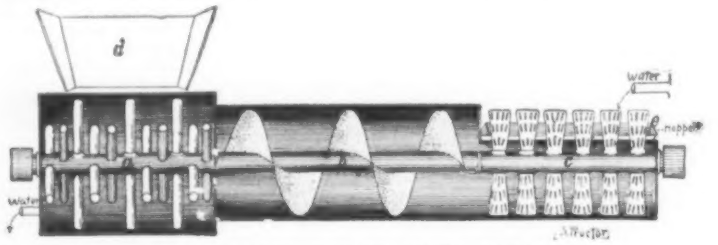


FIG. 1.—MACHINE FOR WASHING POTATOES.

a, spiral of arms for removing dirt; b, perforated screw for moving potatoes toward end of washer next to the comminutor; c, perforated paddles for lifting the clean potatoes into the hopper leading to comminutor; d, hopper for introducing potatoes into washer; e, hopper leading to comminutor.

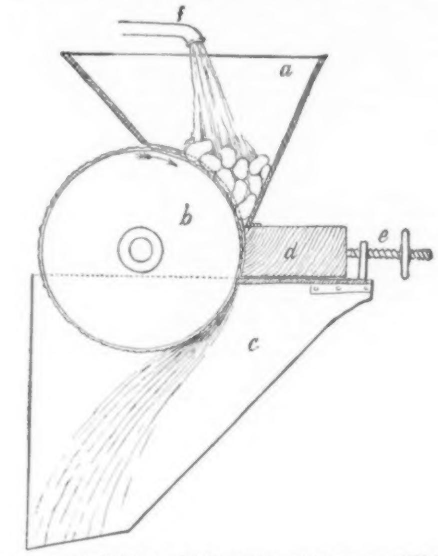


FIG. 4.—RASPING MACHINE—CROSS SECTION.

a, hopper; b, rasp; c, receptacle for pulp; d, buffer; e, setting screw; f, water jet.

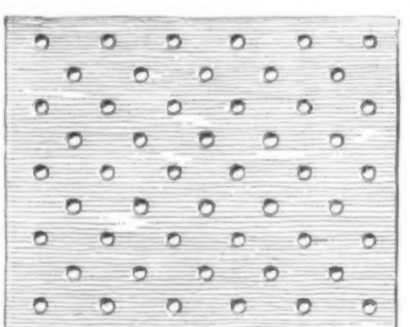


FIG. 2.—SECTION OF SURFACE OF COMMINUTOR.

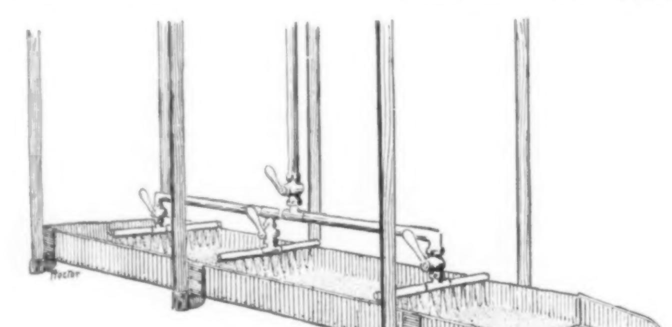


FIG. 5.—STARCH SEPARATOR.

The process of manufacture is extremely simple. The potatoes, which are kept in a storehouse, are carried after weighing, to a revolving washer about 12 feet in length and from 18 to 24 inches in diameter. They are pushed toward the comminutor through the washer by means of a perforated spiral or by arms attached to a revolving axle. A stream of water flowing in a direction opposite to that of the motion of the potatoes secures the final washing with clean water. The principle of the washing apparatus is shown in Fig. 1. By the time the potatoes have reached the comminutor they are practically free from dirt and grit.

The rasping machine consists of a cylinder about 30 inches in diameter and 36 inches long. This cylinder is made of wood and is covered with pieces of sheet iron punched full of holes about one-eighth of an inch in diameter, as indicated in Fig. 2. The rough edges of the iron, resulting from the punch, face outward. These pieces of iron are nailed on the cylinder in sections, and when they have become dulled by use they are taken off and replaced by new sheets. The rate of revolution of the cylinder is about 600 per minute. Some of the rasps are much larger than the one just described, the one at Brown's factory, in Holton, having a capacity of nearly double that just noted. The

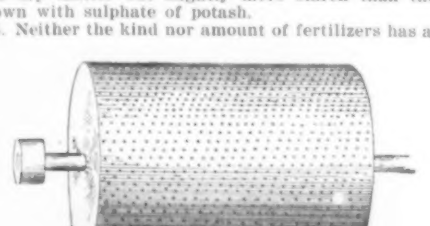


FIG. 3.—RASPING CYLINDER OR COMMINUTOR.

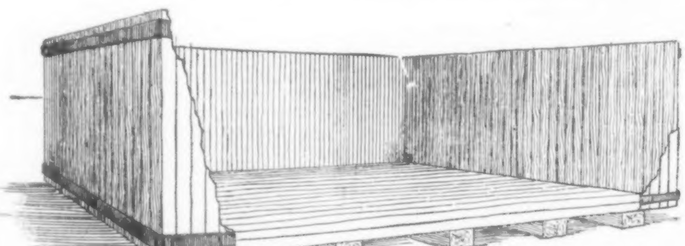


FIG. 6.—SETTLING TANK.

* From Bulletin No. 58, United States Department of Agriculture, Division of Chemistry.

† Total production, 1899, 15,500 tons; Maine and New Hampshire, 9,000 tons; New York, 400 tons; Wisconsin and other Western States, 6,100 tons.

principle of the construction, however, is exactly the same.

The rasping cylinder, with the iron rasps attached, is shown in Fig. 3.

The rasp revolves as near a brace of hardwood as can be, and the potatoes, being stopped by the brace from passing, are reduced to a fine pulp by the rapidly revolving drum (Fig. 4.) Some of the modern factories have specially constructed rasps which are more effective than those just described. The potato-starch factories of Stevens Point, Wis., use a large-size rasp made in Leipzig and having a capacity of 250 bushels an hour. A stream of water is thrown upon the potatoes as they enter the comminutor, so that the pulp is readily washed through as it is reduced to the required degree of fineness.

The various parts of the comminutor are shown in cross section in Fig. 4: *a* represents the hopper holding the potatoes; *b* the wood cylinder or rasp which revolves at a high rate of speed; *c* the hopper in which the potato pulp is received after passing the rasp; *d* the wooden press which is kept in position by means of the screw *e*; through the pipe *f* comes the water which aids in carrying potatoes through the rasp.

The pulp falls from the rasper onto a starch separator, the bottom of which consists of wire gauze having thirty meshes to the inch (Fig. 5). The meshes, however, are not the thirtieth of an inch in diameter, since the thickness of the wire must be deducted therefrom, making the openings of the mesh about one-sixtieth of an inch in diameter. This separator is slightly inclined, so that the shaking process gradually moves the pulp toward the lower end. The starch separator is of the same width as the rasps, namely, about 36 inches, and is 12 feet in length. During the progress of the pulp along the separator, jets of water are thrown upon it from pipes arranged above. The water detaches the starch granules from the pulp, and the granules, being small enough to pass through the meshes of the gauze, are carried through, while the pulp is left upon the screen, to be ejected finally at the lower end. The arrangement of the separator and water jets is shown in Fig. 5.

The pulp, which is a useful cattle food, is thrown away at all the factories in Aroostook County. It does not pay to preserve it in a country where other forms of cattle food are so cheap. The best hay sells at the market in Presque Isle for $5 a ton.

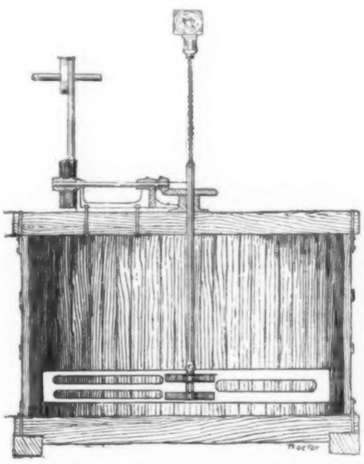


FIG. 7.—STARCH WASHER—INTERIOR VIEW.

In Wisconsin and some of the other Western States, the potato factories are situated on trout streams, and they are forbidden to run their refuse into these streams. In such cases, the refuse is collected in large cisterns dug in the ground. The potato pulp can be fed in fresh condition without bad effect to milk cows or to steers. With a little care it can also be given to sheep, but usually it is allowed to go to waste.

The starch, which is carried through by the water, falls into large tanks. These tanks are of various sizes, namely, from 20 to 40 feet in length and width and from 6 to 8 feet in depth. The starch, when it enters these tanks with the water, rapidly settles to the bottom, and the reddish-colored supernatant water can be drawn off. In a few hours after the tank is filled the starch is all settled in a hard, compact mass in the bottom of the tank. The proportion of starch and water is such that a 4-inch layer of starch will result from a quantity of starch milk which would fill the tank. In other words, 4 inches of starch are overlaid with about 6 feet of water.

The crude starch resulting from the above process, after the water is drawn off, is lifted by shovels and thrown into another tank of somewhat smaller size fitted with a revolving stirrer; water in large quantities is added at the same time, and the starch is beaten into a cream and again allowed to settle. An interior view of this washing tank is shown in Fig. 7. The process is simply for washing the starch and removing the larger portion of impurities. In the second settling the pure white starch first goes to the bottom, and when the water is drawn off it is found to be covered with a thin layer of starch mixed with various forms of impurities. This layer is removed separately, and the pure starch underneath is ready for the drying tables.

The layer of dirty starch removed as above indicated is subjected to a second washing, and, if necessary, to a third, the final separation of the starch which it contains being sometimes effected in starch separators of the usual construction. These are so constructed that the starch cream poured upon them permits the separation of the starch during the flow of the liquid, so that by the time the end of the screen is reached the starch is practically deposited and the dirt and refuse flow away.

The white starch derived from the process just described is dried in kilns of two kinds. The old-fashioned kilns were heated directly by furnaces, the hot air coming from the pipes being used to dry the starch. In the modern kilns, the drying is effected by means of steam coils. These permit a more uniform and more rapid drying, and at the same time diminish the danger of fire, which is very great in the kilns heated directly by furnaces. Very few furnace kilns are now under construction, most of the new ones being provided with steam heaters. The kilns are usually erected at a distance of 100 yards or more from the factory, so that in case of fire the factory building may not be destroyed.

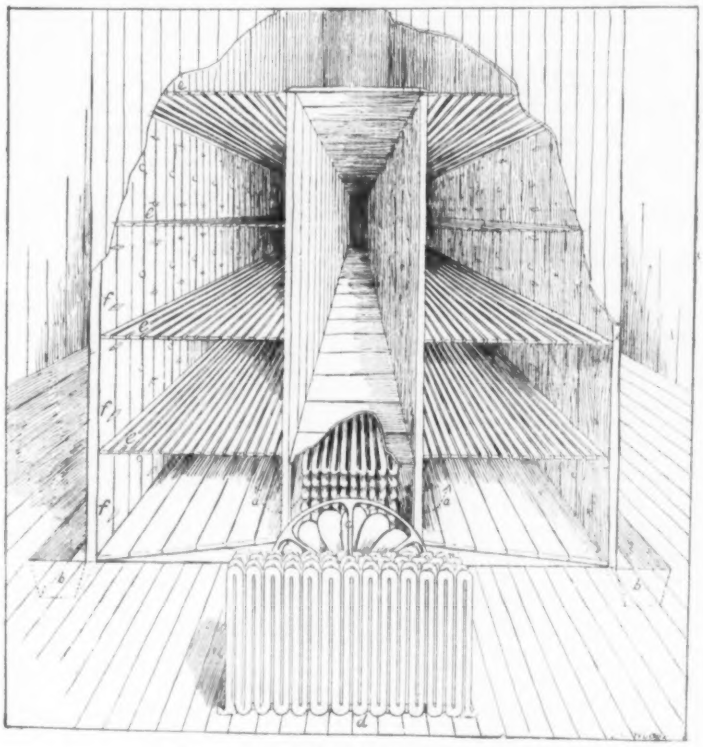


FIG. 8.—DRYING KILN—END VIEW.

In Fig. 8 is seen the end view of the drying kiln, looking back from the fan *c*, which forces the air onto the steam coils *a-a*. The entrance of the air is so arranged by a conduit (not shown) as to cause the whole of it to pass over the coils *d*, in which very cold water circulates. The air in passing over the cold pipes *d* loses a great part of its moisture, so that it is as dry as possible on reaching the heating coils *a-a*.

The different platforms or shelves on which the starch successively falls are shown at *e-e-e-e*. Each shelf is easily reached by doors, the hinges of which are shown at *f-f-f*, so that the starch can be easily raked and made to fall through the spaces between the slats of the shelves, as shown in the figure. The bottom shelf is a solid floor, so that the dried starch can be finally delivered into the troughs *b-b*, which extend along the full length of the drying kiln.

FIG. 9.—TRANSPORTING STARCH TO THE KILN.

After a few hours' drying the large blocks of wet starch fall down in smaller portions on raking, and these smaller portions fall through the slats, shown in the figure, and are caught upon the shelves below. Thus, little by little, the starch which is raked through the shelves becomes drier and drier and is brought into contact with the hot air.

In this way the starch granules are protected from swelling and conversion into a pasty mass, as would otherwise be the case if they were subjected in the wet state to the full temperature of the final drying.

The starch is placed first upon the upper floors, on wooden slats with openings of about half an inch. This is the coolest part of the kiln, so that the starch containing the greatest amount of moisture is subjected to the least degree of heat. It is not safe to submit very wet starch to a high temperature, for there would be danger in this case of converting it into paste and rendering it unfit for market. When the starch is partially dried it is raked over the grated floor, and the particles which are dry enough to be easily detached fall through and strike similar grates below. This process of raking over the various layers of starch continues until the starch in a fine powder finally reaches the lower floor in a state of dehydration suitable for barreling. It requires about twelve hours to complete the drying when the most effective kilns are employed, so that the kilns are charged with the wet starch, as a rule, twice a day. The size of the kilns is, of course, proportionate to the capacity of the house. For a house using 1,200 barrels of potatoes a day the kilns are about 40 feet long and 30 feet wide, and the shelves on which the starch is dried are about 15 feet in height.

The dried starch is finally raked off of the lower floor into a trough along the side of the kiln, whence it is placed in the barrels already mentioned. In some of the steam kilns the drying is accelerated by a blast produced by a blowing fan. The cold air, before being forced into the kiln by the fan, is passed over a series of iron tubes filled with cold water, which takes from the air a considerable proportion of moisture which otherwise would enter the kiln. It is evident, from the description of the kiln which has been given, that the hottest and driest air strikes the driest

starch first, the air being successively cooled and becoming more and more saturated with moisture as it passes upward to the wetter layers of starch.

The wet starch in lumps of various sizes is transported over a bridge connecting the kiln and factory, either on a small railway or, more often, in wheelbarrows, as shown in Fig. 9.

After the starch is thoroughly dried, it is carried to the warehouse, where it is placed in heaps, in order that the moisture may be evenly distributed throughout the mass. It is evident from the method of drying that some parts of the starch come from the kilns much drier than others. If the barreling take place at once, the percentage of moisture in the marketed product is not uniform. Uniformity of moisture is secured by placing the starch in large warehouses, where it resembles banks of driven snow.

After the mass of starch has become uniform in its content of moisture, it is placed in barrels, and is then ready for transportation.

The wholesale prices of the principal starches and dextrins in the United States for the several months of the year 1899 are given in the following table:

Extreme wholesale prices of the principal commercial starches and dextrins for the year 1899.

[Compiled from the weekly quotations of The Oil, Paint and Drug Reporter.]

Month.	Starches.						Dextrins.		
	Corn, pearl, in barrels.	Potatoes.	Rice.	Wheat.	Sago flour.	Tapioca flour.	Imported.	Domestic.	Corn.
	Cents per lb.	Cents per lb.	Cents per lb.	Cents per lb.	Cents per lb.	Cents per lb.	Cents per lb.	Cents per lb.	Cents per lb.
January	1.40-2.00	3½ -4	....	5-6	3½ -3⅞	4 -4½	5¾ -7	5¼ -6	2.15-3
February	1.40-1.60	3⅞ -4¼	....	5-6	3⅞ -4¼	4¼ -4¾	6 -6¼	5¼ -5¾	2¼ -3
March	1.40-1.60	4 -4½	....	5-6	4 -4¼	4½ -5	6 -6¼	5¼ -5¾	2¼ -3
April	1.45-1.60	4¼ -4¾	....	5-6	4 -4¼	4½ -5	5⅞ -6⅛	5¼ -5¾	2⅜ -3
May	1.43-1.60	4½ -4¾	...	5-6	3⅞ -4¼	4½ -5	5⅞ -6⅛	5½ -6	2⅜ -3
June	1.40-1.65	4½ -4¾	7½-8½	5-6	3¾ -4	4½ -5	5⅞ -6⅛	5½ -6	2½ -3
July	1.44-1.65	4½ -4¾	7½-9	5-6	3¾ -4	4¾ -5	5⅞ -6⅛	5½ -6	2½ -3
August	1.44-1.65	4½ -4¾	7½-9	5-6	3¾ -4	4¾ -5	5¾ -6⅛	5½ -6	2½ -3
September	1.39-1.60	4½ -4¾	7½-9	5-6	3¾ -4	4¾ -5	5¾ -6	5½ -6	2¼ -3
October	1.45-1.60	4 -4¾	7½-9	5-6	3⅝ -3¾	4⅞ -5¼	5¾ -6¼	5¼ -6	2¼ -3
November	1.55-1.60	4 -4¾	7½-9	5-6	3⅝ -3¾	4⅞ -5¼	5¾ -6¼	5¼ -6	2⅜ -3
December	1.52-1.60	4 -4¾	7½-9	5-6	3½ -3¾	4⅞ -5¼	5⅝ -6¼	5½ -6	2⅝ -3
Minima	1.39-1.50	3½ -3¾	7½-8½	5-6	3⅜ -3¾	4 -4¼	5⅝ -6	5¼ -5½	2.15-2.25
Maxima	1.55-1.65	4½ -4¾	7½-9	5-6	4 -4¼	4⅞ -5¼	6¼ -7	5½ -6	2½ -3
Means	1.46-1.61	4.21-4.57	7½-9	5-6	3.73-3.98	4.63 -4.96	5.87-6.17	5.40-5.88	2.37-2.96

From the above table it will be noticed that there are very wide ranges in the prices of starches of different origin, the indian-corn starch of the highest grade being the cheapest of all, while rice starch commands the highest price.

Dextrin, or British gum, is one of the principal products derived from starch. The price of this article also varies greatly, the imported dextrin and dextrin of domestic origin made from other starches than indian corn commanding the highest price, the imported article, which is made almost exclusively of potatoes, having the highest price of all. On the other hand, domestic dextrin made from indian-corn starch is only a little over half as valuable as the others.

Potato starch possesses peculiar properties, rendering it especially valuable for use in print works. Nearly all of the potato starch manufactured in Aroostook County is sold to print works in Massachusetts, Rhode Island, and other parts of New England. The makers of prints are willing to pay a considerable increase in price for potato starch over that which they would have to pay for starch made from indian corn. This higher value has led, according to information received from several quarters, to the adulteration of potato starch with indian-corn starch to a considerable extent.

SOLDERING ALUMINIUM.

By JOSEPH A. STEINMETZ.

UPON attempting, with any ordinary solder, to join sheets of the metal, it is noticeable that the mixture does not take hold, but tends rather to run off, or perhaps it will chill, utterly refusing to tin the sheets, and rarely adhering to the aluminium. The reason of this behavior is that there is always present a thin, continuous coating of oxide, which effectually prevents the solder from getting to the true metal beneath. This thin, almost invisible, skin of alumina, or oxide of the metal, is of instantaneous formation, and the surface of the metal may be scraped or filed without even temporary relief, because of the immediate renewal of the coating.

The use of fluxes and acids to overcome this difficulty has been repeatedly suggested, without securing satisfactory results, and a new theory tending toward the solution of the problem must needs be approved. Dr. Joseph W. Richards, of Lehigh University, Bethlehem, Pa., conceived the successful practice of overcoming the difficulty by incorporating into the composition of the solder an ingredient that would remove the oxide film during the process of soldering, thereby preserving the surfaces clean until the union of the parts had been accomplished. The solder devised and patented by Dr. Richards carries in its make-up an alloyed flux of phosphorus in tin, the theoretical necessity of the simultaneous action of the flux and the taking hold by the solder being confirmed during many years by the satisfactory results obtained in actual commercial practice.

The high heat conductivity of aluminium is another characteristic of this strange metal, and the refusal of many solders to perform their expected duty is traceable to it. The aluminium quickly and readily absorbs the heat from the soldering iron, and the temperature of the tool is thus so far reduced that the solder "freezes" at the joint, and failure ensues. To overcome this difficulty, which arises in large work particularly, it is necessary to keep the soldering iron very hot, and oftentimes it tends to the betterment of the result to apply heat likewise to the parts to be joined. —Cassier's Magazine for March.

THE SOLUBILITY OF SUBSTANCES USED IN THE OIL AND COLOR INDUSTRIES.

By HERBERT ROBSON, B.Sc.

BY solubility we ought to mean and to be entitled to understand the conversion of a solid into a liquid by contact with another substance or substances already in the liquid state, with or without the aid of heat. Nothing is known about solution, as the change from solid to liquid under these conditions is called, except the bare facts of the individual cases, so that there is no necessity for the writer to enter upon any theoretical disquisitions on the theories which have been broached on the subject. Sugar is soluble in water, and platinum is not, but of the why and wherefore we are utterly ignorant in both cases. We do not even know under which department of science the study of the phenomena of solution belongs. One point in the nomenclature of the subject, however, deserves attention, says Oils, Colours, and Drysalteries. It is best to discard the term "melt" and its inflections altogether, as it is used indiscriminately to describe cases of solution of a solid in a liquid solvent, and cases of the liquefaction of a solid by sheer heat, without the intervention of any second substance, which certainly belongs to a different class of phenomena altogether. The proper word for this second kind of liquefaction is fusion. With regard to solution in general, it is convenient to divide substances which have to be dissolved into organic and inorganic bodies, the former being those which are obtained from bodies which are or have been alive, i. e., from those of plants and animals, while the latter belong to the so-called mineral kingdom, and are either dug directly out of the ground of which they form an integral part, or are obtained by manufacturing processes having such substances as their raw material. It is hardly necessary to say that the great majority of solid bodies used in the oil and paint trades belong to the former category, and that the majority of these are of vegetable origin.

As a rough rule it may be laid down that an inorganic solid requires for its solution an inorganic solvent, and an organic solid an organic solvent. Those inorganic bodies, however, which are insoluble in the greatest of all solvents—water—are usually insoluble altogether as such, solution only taking place at the expense of chemical change. Thus, the only practical solvent for white lead is nitric acid, which in the act of dissolving it changes it from the carbonate of the metal to the nitrate. Organic solids, as a general thing, dissolve in organic solvents, so far as can be judged as such, for they can usually be recovered in their original condition by removing or destroying the solvent, or by swamping the latter with another liquid in which the solid concerned will not dissolve. Thus, the evaporation of a solution of shellac in spirit will give a residue resembling in all respects the original solid. This can also be got as a precipitate by diluting the varnish with water, or by acting on the alcohol with any chemical reagent that will affect it rather than the shellac. The exact condition of the shellac while in solution we do not, however, know, as has been stated, and for industrial purposes it does not much matter what it is.

Broadly speaking, then, from our point of view, we have to regard inorganic bodies from the point of view of their solubility in water. If they are insoluble, or practically so, in that menstruum, there is no more to be said. It has been asserted, and the assertion is quite possibly true, that no substance is absolutely insoluble in water. Still, many are so nearly so, barytes, for example, that for commercial purposes the case is the same as if they were strictly indifferent to the solvent action of hydrogen monoxide. If, however, the substance is distinctly soluble in water, the question of the degree of solubility becomes an important factor in the question, and it is found that as a practically invariable rule, the solubility of any one substance in water increases with the temperature. The only common exception to the rule is lime, which is less soluble in hot than in cold water. The solubility of common salt, too, which is about one in four of water, by weight, increases very slowly indeed with rise of temperature, but it does increase. With the vast majority of inorganic substances soluble in water, the solubility increases very rapidly with rise of temperature.

The organic solids used in the oil and color trades are almost without exception insoluble in water for all practical purposes.

The reader will now easily gather on what lines the following particulars of the insolubility of substances used in connection with the oil and paint trades will proceed. We begin, then, with

A. INORGANIC SUBSTANCES.

Insoluble in water, and only dissolving in other liquids, if at all, with decomposition.

White lead	Magnesite
Litharge	Whiting
Lead sulphate	China clay
Lead sulphite	Vermilion
Zinc oxide	Ultramarine
Zinc sulphide	Prussian blue
Mars pigments	Smalt
Realgar	Cobalt blue
Cadmium yellow	Copper blues
Chrome	Umber
Copper greens	Red lead
Cobalt green	Iron sesquioxide
Lamp blacks and bone blacks	Antimony sulphide
	Lead chromate
Barytes	Zinc chromate
Gypsum	Ochers
Strontian white	Siennas

B. INORGANIC SUBSTANCES.

Soluble in water.

In all cases the figures given after the name of the substance denote the number of parts by weight of it which will dissolve in 100 of water, at the temperature indicated.

	Ordinary Temperature.	Boiling.
Borax, dry	2½	5
Borax, crystallized	50	200
Alum, dry	4½	70
Alum, crystallized	9	420
Ammonia chloride	35	77
Ammonia carbonate in its own weight of water		
Ammonia sulphate	74	103
Arsenious acid	1	10

Arsenious acid is practically insoluble in alcohol or ether. 1,000 parts of castor oil will dissolve 1½ of white arsenic at ordinary temperatures, and 9 at the boiling point of water.

	O. T.	B.
Corrosive sublimate	7	54

Bichloride of mercury dissolves in twice its weight of absolute alcohol. It is barely soluble in ether.

	O. T.	B.
Green vitriol	20	42
	insoluble in alcohol	
Bichromate	10	100
Yellow prussiate	28	90
Red prussiate	38	77

Both prussiates are insoluble in alcohol.

	O. T.	B.
Sulphate of potash	10	26
Carbonate of soda	16	45
Nitrate of soda	87	168
Zinc sulphate, dry	50	95
Zinc sulphate, crystallized	150	653
Nitrate of potash	26	247

Sulphur is the only inorganic substance with which we are concerned that requires organic solvents. The most usual of these is bisulphide of carbon, 100 pounds of which will dissolve 37 of sulphur at ordinary temperatures and 180 at 55 deg. C. 100 of benzole will dissolve 1 of sulphur at common temperatures and 4 at 70 deg. C. Brimstone is freely soluble in oil of turpentine, 100 parts by weight of which will, when boiling, dissolve 16 of sulphur. Sulphur is very slightly soluble in alcohol, ether and glycerin.

C. ORGANIC SUBSTANCES.

It must not be forgotten that some of these are mixtures of different substances, each having its own special solubilities, and that, moreover, these mixtures are by no means of constant composition. This makes the statement of solubilities for the thing as a whole very difficult, but we are giving here what it appears from the best accounts available are the solubilities of average specimens. It will be noted that no figures are given. The reason for this is to be sought for in the remarks just made about the composition of the organic bodies with which we have to deal. The organic bodies used by or in connection with the oil and paint trades may now be considered in the two following classes:

Among the organic solvents for organic solids, alcohol has by far the foremost place. Just as it occupies the place in organic chemistry that water does in inorganic, so it is as a solvent for organic matter what water is for mineral substances. Next to it come at a very respectful distance such solvents as ether, benzole, oil of turpentine, chloroform and oils. The following list gives the chief solubilities of the principal substances connected with the oil and color industry.

Gums.

Arabic.—Soluble in water very easily, and practically insoluble in everything else. Quite insoluble in alcohol, ether and oils.

Tragacanth.—Partly soluble in water. Insoluble in alcohol.

Beeswax.—Insoluble in water. Soluble in benzole and oils. Partly soluble in alcohol, ether and acetone.

Carmine.—Soluble in water and alcohol. Barely soluble in ether. Soluble unchanged in hydrochloric or sulphuric acid.

Indigo.—Practically insoluble in everything except hot concentrated oil of vitriol. Traces of it dissolve in hot alcohol and oil of turpentine, but separate out again on cooling.

Resins.

Guiacum.—About 9 per cent of this resin dissolves in water. It is soluble in alcohol, ether, oil of turpentine and caustic soda, but insoluble in benzole.

Myrrh.—Partly soluble in water, alcohol, ether and caustic soda.

Gamboge.—Soluble in alcohol. More soluble in ether. Soluble in benzole and in caustic soda.

Benjamin.—Soluble in alcohol, but scarcely in ether. Insoluble in benzole. Soluble in caustic soda.

Copal.—Scarcely soluble in alcohol, benzole, or oil of turpentine, insoluble in cold caustic soda. Soluble in ether. The solubility is much increased by fusion.

Dammar.—Partly soluble in alcohol and ether, barely in caustic soda.

Dragon's Blood.—Soluble in alcohol, ether and oil of turpentine.

Elemi.—Soluble in alcohol.

Ammoniac.—Easily soluble in spirit of ether. Insoluble in caustic soda.

Anime.—Soluble in oil of turpentine. East India anime is said to be insoluble in alcohol, and South American to be soluble.

Gutta Percha.—Insoluble in alcohol or ether. Soluble in chloroform, bisulphide of carbon, benzole, and oil of turpentine.

Shellac.—Soluble in alcohol, borax and caustic soda. Insoluble in benzole or ether.

Mastic.—Mostly soluble in alcohol and benzole. Completely soluble in ether and oil of turpentine.

Peru Balsam.—Soluble in alcohol, partly soluble in ether.

Tolu Balsam.—Easily soluble in caustic soda, alcohol and ether.

Sandarac.—Easily soluble in alcohol, ether and oil of turpentine, in acetone and caustic soda.

Rosin.—Soluble in ether, alcohol, wood-spirit and oil of turpentine.

The resinates of lead and manganese are insoluble in alcohol, slightly soluble in ether, and freely soluble in oil of turpentine.

SOME ANIMALS EXTERMINATED DURING THE NINETEENTH CENTURY.

WHILE the century which has just closed may fairly lay claim to the gratitude of posterity on account of the magnificent tale of zoological work accomplished during its course, it is, on the other hand, undoubtedly open to the charge of having permitted the total extermination of not a few animals, and of having allowed the numbers of others to be so reduced that their disappearance, at least as truly wild creatures, can scarcely be delayed very many years longer. Possibly, if not probably, the sweeping away of the enormous herds of many species, like those of the American bison, may have been an inevitable accompaniment of the march of civilization and progress; but there is no sort of excuse to be made for the fact that in certain instances naturalists failed to realize that species were on the very verge of extermination, and that they were actually allowed to disappear from the world without being adequately represented in our museums. Nor is it by any means certain that even the present generation is altogether free from reproach in this matter, although it cannot be said that any species hovering on the verge of extermination are absolutely unrepresented in collections. Whether, however, sufficient specimens of such species are being preserved for our successors may be an open question.

It is not our intention in this article to allude to the host of animals whose numbers have been reduced in such a wholesale manner during the century as to render them in more or less immediate danger of impending extermination, but to confine our attention in the main to those on whom this fate has already fallen. And here it may be mentioned with satisfaction that India enjoys a remarkably good record in this respect, for, so far as we are aware, it has not lost a single species of mammal, bird or reptile, either during the nineteenth century or within the period of definite history. It is true that the numbers and range of the Indian lion have been sadly curtailed during the last fifty years, and that if steps are not promptly taken for its protection, that animal may, ere long, disappear from the Indian fauna. But, at any rate, it has not done so at present; and even were it exterminated in the country, this would not mean the extermination of a species, and possibly not even of a local race, since it is not improbable that the Persian representative of the lion (which is still abundant) may not be distinguishable from the Indian animal. Of large animals peculiar to India, perhaps the great Indian rhinoceros is the one that requires most careful watching in order that its numbers and its range may not be unduly reduced before it is too late to take adequate measures for its protection. And in this connection it is perhaps legitimate to call the attention of sportsmen and native princes to the urgent need of a fine specimen of this magnificent animal for the collection of the British Museum.

We have said that the century is responsible for the extinction of no inconsiderable number of the world's animals. But it must not for one moment be supposed that, within the historic period, no such exterminations by human agency had taken place in previous centuries. We have to go back so far as the year 1615 for the last evidence of the existence, in a living state, of the great flightless rail (*Aphanapteryx*) of Mauritius and Rodriguez; while the journal of the mate of the "Berkley Castle," in 1681, is the last record of the dodo being seen alive. Again, the tall and flightless solitaire of Rodriguez is not definitely known to have been met with by Europeans after 1691, although there is some evidence to indicate that it may have lingered on in the more unfrequented portions of the island till as late as 1761. Of the extinct géant, or Mauritian coot (*Leguatia*), we have no evidence of its existence subsequent to 1695; while our last record of the crested parrot (*Lophopsittacus*) is as far back as 1601. Again, the great northern sea-cow (*Rhytina gigas*), which was only discovered on the islands of Behring Sea in the year 1741, had entirely ceased to exist by about 1767. Moreover, the giant tortoise of Réunion appears to have ceased to exist on its native island previous to the dawn of the nineteenth century, although at least one exported example has survived till our own day.

Neither can the nineteenth century be held responsible for the extermination of the South African blaauwbok (*Hippotragus leucophoeus*), a smaller relative of the familiar roan antelope, since the last known example is believed to have been killed in or about the year 1799. It had always a curiously restricted habitat, being confined to a small area in the Swellendam district.

On the other hand, the great auk is a bird whose loss we owe to the carelessness of the naturalists of the middle of the nineteenth century, for there is little doubt that if protective measures had been taken in time it might have been alive at the present day. From the American side of the Atlantic it probably disappeared somewhere about the year 1840; while the summer of 1844 witnessed the destruction of the last European pair of this remarkable bird, the last British representative having been hunted to death in the neighborhood of Waterford Harbor ten years previously.

One of the most sad stories of extermination, and that, too, at a comparatively recent date, is revealed in the case of the South African quagga. According to Mr. H. A. Bryden, who has devoted a great deal of attention to the subject, the extermination of this zebra-like species in the Cape Colony took place between the years 1865 and 1870, and probably between the latter year and 1873 in the Orange River Colony, which was its last stronghold. The extermination of this species may be attributed entirely to the pernicious trade of hide-hunting, for in the first half of the century it was to be met with in thousands on the grass veldt, and formed the staple food of the Hottentot farm laborers of the Graaf Reinet and many other districts. What makes the matter still more melancholy is that specimens of the animal could easily have been procured in any numbers, both for our menageries and our museums, but that (probably owing to the circumstance that naturalists were ignorant of its impending fate) no steps were taken in the matter. In the year 1851 a female was purchased by the Zoological Society of London, while seven years later a male was presented to the same body by the late Sir George Grey. The latter survived till 1872, and was thus one of the last survivors of its race. Although the fact of the practical accomplishment of the extermination of the species at that time appears to have been unknown in London, the skin of Sir George Grey's specimen was luckily preserved, and may now be seen mounted (albeit in a somewhat worn and faded condition) in the British Museum as the solitary representative of the species. Fortunately, the skeleton of this specimen was likewise preserved for the national collection.

Several photographs of the above-mentioned individual are in existence, and the Royal College of Surgeons possesses a small oil-painting, by Agassiz, of one of a pair of quaggas which were driven in harness by Mr. Sheriff Parkins in Hyde Park early in the nineteenth century. Of these two animals the college likewise possesses the skulls, which were acquired with the collection of Mr. Joshua Brookes on its purchase in 1828.

In addition to Sir George Grey's specimen, the British Museum formerly had the skin of a young quagga, in very bad condition, which was presented by the traveler William Burchell, and was subsequently described by Hamilton Smith as a distinct species, under the name of *Hippotigris isabellinus*. Apparently London museums possess no other relics of this lost species, of which, however, we believe there is an example in the museum at Edinburgh. As the animal yielded no trophies worthy the attention of the sportsman, it is unlikely that there are any specimens in private collections, unless, perchance, a skull or two may be in existence. The lack of other relics of such a common species affords a signal instance of lost opportunities, and should serve as a warning against our permitting a similar remissness to occur in the case of any other species threatened with extermination.

Mention has already been made of the extermination of the giant land tortoise of Réunion during the eighteenth century; and in the early part of its successor four other species became extinct in the neighboring islands of the Mascarene group, namely, *Testudo indica*, *T. triserrata* and *T. inepta* in Mauritius, and *T. vosmaeri* in Rodriguez. It has likewise been considered probable that the thin-shelled tortoise (*T. abingdoni*), of Abingdon Island, in the Galapagos group, is also no longer existing, although it was certainly alive as recently as 1875.

Of birds that have disappeared during the century, in addition to the great auk, reference may first be made to the black emeu (*Dromaeus ater*), of Kangaroo Island, South Australia. When this island was explored in 1803 by a French expedition, these birds were abundant, and three were sent home to Paris, where a pair lived till 1822. On their death, the skin of one and the skeleton of the other were mounted for exhibition in the Paris Museum, where they still remain. Of the third specimen no record was obtainable till 1900, when, as already noticed in this journal, its skeleton was discovered by Prof. Giglioli in the museum at Florence. These three priceless specimens are the only examples of a species which became extinct in the native state previous to the death of the Paris pair, and before it was even known to be different from the larger emeu of the mainland. For it appears that some years after the visit of the French expedition (to which Péron was naturalist) to Kangaroo Island, a settler squatted there and forthwith set to work to make a clean sweep of the emeus and kangaroos—a task in which he was only too successful.

Before the middle of the century another large bird appears to have made its final exit from this world. When Steller discovered the northern sea-cow in the islands of Behring Sea, he also brought to the notice of science a new species of cormorant (*Phalacrocorax perspicillatus*), which was especially interesting on account of being the largest representative of its kind, and likewise by the bare white rings round its eyes and the brilliant luster of its green and purple plumage. Stupid and sluggish in disposition, Pallas' cormorant, as the species is commonly called, appears to have been last seen alive about the year 1839, when Captain Belcher, of H.M.S. "Sulphur," was presented with a specimen by the Governor of Sitka, who also forwarded other examples to Petersburg. Captain Belcher's specimen is preserved in the British Museum, and three other skins are known to be in existence elsewhere.

The great white water-hen (*Notornis albus*), formerly inhabiting Lord Howe and Norfolk Islands, must be added to the defunct list. And the same is the case with the Tahiti rail (*Prosobonia leucoptera*) and Latham's white-winged sandpiper (*Hypotaenidia pacifica*), the latter of which in Captain Cook's time was abundant in the island above named, as well as in the neighboring Eimeo. The New Zealand quail (*Coturnix novaezealandiae*) is likewise entered in the British Museum list as extinct. The beautiful *Pigeon hollandais*, so called from its plumage presenting the Dutch colors, and technically known as *Alectoroenas nitidissima*, is a Mauritian species whose extermination probably took place during the century. It is known solely by three examples, one of which is preserved at Port Louis, the second in Paris, and the third in Edinburgh.

Nor must we omit from our list two species of Kaka parrot, one of which (*Nestor productus*) was a native of Philip Island, while the home of the second (*N. norfolcensis*) was the neighboring Norfolk Island. A species of parraquet (*Palaeornis exsul*), peculiar to the island of Rodriguez, is also believed to be exterminated.

Neither has the duck family escaped, for the well-known pied duck (*Camptolaemus labradorius*), an ally of the eider from the North Atlantic coast of America, appears in the defaulters' list, the last-known example having been killed in 1852.

Passing on to Passerine birds, a notable loss is the handsome crested pied starling (*Fregilupus varius*) which is believed to have become extinct about the middle of the century. Of the few remaining examples of this striking species one is preserved in the British Museum. Another species, exterminated within approximately the same period, is the gorgeous black and gold mamo, or sicklebill (*Drepanis pacifica*), of Hawaii, whence it was first brought to Europe by Captain Cook. As narrated in the "Birds of the Sandwich Islands," by Messrs. Scott Wilson and Evans, the extermination of this beautiful species is to be attributed to persecution for the sake of its yellow feathers, which were used for the cloaks of the native chiefs. About four specimens are known to be preserved in museums.

Of birds that have been locally exterminated, such as the burrowing petrel (*Oestrelata haesitata*), known in the Antilles as the diablotin, it is not our intention to speak on this occasion. And this article may accordingly be fitly brought to a close by an extract from Prof. A. Newton's "Dictionary of Birds," referring to two instances where species may have perished within the century without having ever come definitely under the notice of ornithologists. After stating that one Ledru accompanied an expedition dispatched by the French government in 1796 to the West Indies, the professor proceeds to observe that this explorer "gives a list of the birds he found in the islands of St. Thomas and St. Croix. He enumerates fourteen kinds of birds as having occurred to him then. Of these there is now no trace of eight of the number; and, if he is to be believed, it must be supposed that within fifty or sixty years of his having been assured of their existence they have become extinct. . . . If this be not enough, we may cite the case of the French islands of Guadeloupe and Martinique, in which, according to M. Guyon, there were once found six species of Psittaci, all now exterminated; and it may possibly be that the macaws, stated by Gosse and Mr. March to have formerly frequented certain parts of Jamaica, but not apparently noticed there for many years, have fallen victims to colonization and its consequences."—R. L., in Nature.

THE PROPER USE OF SODIUM NITRATE AS A FERTILIZER.

THE fertilizing action of sodium nitrate cannot be successfully questioned, but it should be used with discretion. It is often applied too bountifully, and again too sparingly, by uninformed cultivators, and its benefits are thereby lost.

Its quality is very variable. There are five principal sorts: The white (64 per cent of nitrate); the yellow; the gray (46 per cent); the crystalline gray (20 to 25 per cent); and the white *caliche*, of Peru, which is of exceptional purity.

The ore is fused and crystallized before exportation.

It is especially a spring fertilizer, acting principally by the nitrogen which it furnishes to the plants, and not by the soda which it contains, the soil being generally sufficiently supplied with this. The nitrogen it yields is of great solubility, and, used after the spring rains, it is not drawn too deeply into the soil, and is taken up by the plants at the time when vegetation is starting and the conditions are the best for realizing its benefits.

It is, above all, a fertilizer for cereals. It is of great service when wheat is of yellowish appearance, and the growth is backward. It should then be applied in the proportion of 150 kilogrammes to the hectare. This amount imparts a decided stimulus. The vegetation becomes active, and the wheat soon shows the advantage in its improved color. On the contrary, if the wheat is well developed and of fine appearance, the application of the nitrate might be attended with danger from laying it flat.

Generally, sodium nitrate is employed "*en couverture*" (under cover),* care being taken to spread it as uniformly as possible; but, to obtain the best results, it is needful to act under circumstances the most favorable for the assimilation of the nitrate by the plants. In order that the fertilizer should not attach itself to the young shoots of the wheat, a time should be selected, if possible, when the weather is dry, but when there is a prospect of rain. Often these conditions cannot be realized. So, in many cases, there should be no hesitation in burying the nitrate with the harrow in order to facilitate its diffusion in the soil. Besides, the harrowing, which it is well to follow with rolling, has an excellent effect on the young wheat, favoring the shooting of sprouts from the roots.

When the land is poor in phosphoric acid and has received no phosphoric enriching at the time of sowing, it is well to add to the nitrate from 250 to 300 kilogrammes of superphosphate. But it is requisite to take the precaution of not mixing the two fertilizers except at the moment of spreading, in order to avoid the disengagement of nitrogen, which may otherwise be produced.

In lands poor in calcareous matter, 250 or 300 kilogrammes of plaster can be added with benefit.

The nitrate also facilitates the dissolution of the earthy phosphates in the soil and hastens their absorption by the plants. It promotes the appropriation of considerable quantities of phosphoric acid, of potash and of lime. These three constituents ought to be found in sufficient quantity in the soil.

The influence of the nitrate is not less on plants of forage than on cereals. Its action is marked at all seasons, provided that the soil is sufficiently supplied

* Mulching, to retain moisture, after the plants are started.—*Trans.*

with the necessary nutritive elements already referred to. Its action is peculiarly efficacious in periods of drouth. The more abundant vegetation on the part of a meadow or a field that has received the nitrate, noticed in a dry season, is explained by the fact that plants require less water when the soil is fertile, because they are more readily saturated with the nutritive constituents of the soil. When the soil is poor, the absorption of water is necessary, and if it is lacking, the development is retarded.

By the intelligent employment of sodium nitrate for forage plants, not leguminous, the cultivator may obtain, as experience proves, a product of better quality and one-half more abundant.

The good effects of the nitrate are also manifest on plants cultivated with the hoe, as beets and potatoes. Usually its application *"en couverture"* is not to be counseled. Numerous observations have shown that the preferable practice is to bury it in the spring before planting. The yield is then much less uncertain. This fact is accounted for in part by the corrosive properties of the sodium nitrate, which may burn the young plants by forming places in the soil where the solution is more concentrated and the substance more powerful in its action, and in part by the difficulty of finding a time for its application under the best conditions. But when the crop is suffering and there is a lack of nitrogen, which is indispensable for favorable growth in the case of the beet, the application of the sodium nitrate, although tardy, may be attended with exceedingly favorable results, if the rains favor its diffusion.

Agriculturists have, therefore, at hand a fertilizer, which may produce the best effects. By employing it with discretion, they may often redeem a crop threatened with failure. It is well to warn them against the danger of its indiscriminate use, and to point out the circumstances most favorable for its mode of action.—Compiled and translated from France Agricole.

THE NAVAL WAR GAME.

OPENING GAME UNDER THE REVISED RULES.

A large naval war game was recently played at Portsmouth under the revised rules. The principal changes may be tabulated as follows:

(1) Instead of being limited to 4,000 yards, guns may now fire up to 10,000 yards in any ships assumed fitted with rangefinders, so long as the rangefinders are not shot away. The chances of a hit at 10,000 yards are, of course, very slight; but at 8,000 or 7,000 there is some prospect of hitting according to the scale set down. This is done by dice, the scale being 10,000 to 8,000 yards, 1 in 12; 8,000, 1 in 6; 7,000, 2 in 6; 6,000, 3 in 6; 5,000, 4 in 6. If the dice are favorable, a player is then allowed to use the 4,000 yard target. Possibly he misses at that, still he has his chance.

(2) Torpedoes fitted with gyroscopes are allowed the actual runs of 2,000 yards. Again, with a very small chance of hitting a ship, but at a fleet there is a fair prospect of hitting something.

(3) Modern auxiliary appliances to quick-firing guns are allowed for as follows:

Q.F. with electric hoists fire 5 consecutive moves, then stop 2.

Q.F. without electric hoists fire 3 consecutive moves, then stop 2.

If fitted with transmitters and receivers they fire six consecutive moves and only stop for one move. This is a convention adopted to make the difference felt. It is felt in the ratio 30 to 21, which works out that two guns in an Elswick cruiser—these being always up to date in such appliances—are about as good as three in a British navy cruiser, though the guns themselves are identical. It seems a big difference, but as all rules in the Jane naval war game are the result of a consensus of expert opinion, it must be regarded as not far out. These results were arrived at independently in the British, American, and Russian navies.

Wednesday night's battle was fought under these new rules, with a view to testing them in practice. A number of the very newest ships were employed, the rival admirals selecting their fleets beforehand from lists of certain navies laid down by the umpire.

The red were gunnery officers, blue were all-comers—the all-comers including a number of Japanese officers besides the British. The fleets were:

Red (Gunnery).

	Speed allowed, knots.
Battleship division—	
"London"	18
"Bulwark"	18
"Venerable"	18
"Duncan" (flag)	18
Cruiser division—	
"Yakumo"	18
"Asama"	18
"Idzumo"	18
Two destroyers (French type)	24

Blue (Torpedo and other Officers).

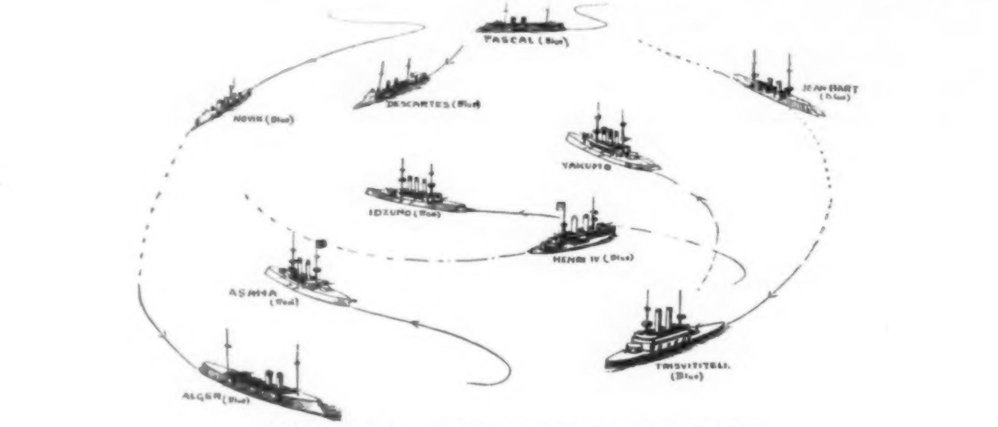
	Speed allowed, knots.
First division—	
"Borodino" (flag)	18
"Retvisan"	18
"Mikasa"	15
"Peresviet"	18
Second division—	
"Trisvititelia"	12
"Henri IV."	15
"Jean Bart"	18
"Descartes"	18
"Pascal"	18
"Alger"	18
"Novik"	24
Three destroyers (British type)	30
Four submarines	9

The blue admiral selected a non-homogeneous fleet in preference to a homogeneous one, in order to get the makeweight of four sumarines. There was a different player to each ship.

Both admirals made very good dispositions, bearing in mind the fact that neither knew the composition of the hostile fleet. Red chiefly adhered to line ahead or a bow and quarter line in two divisions about 4,000 yards apart. Blue adopted line abreast changing a line ahead at intervals. About 3,000 yards separated his divisions—though for purposes of trying to lure the enemy between, he now and again widened out considerably. The submarines he sent on well ahead of him. Red was entirely ignorant that these were being used.

Fire was opened at 10,000 yards, and the fleets zigzagged toward each other as indicated in the plan. At 8,000 yards the "Borodino" was twice hit, once in reds turned all together, using their engines to bring them round. Being relatively stationary they were a better target, and the "Mikasa" put a 12-inch shot into the "Duncan's" engine-room, and ripped her waterline with another. Most of the damage done was about this time, some of the blues being within 3,000 yards, the nearest the battleships ever approached each other. On their side, the "Retvisan" was badly mauled, and practically put out of action, and the "Peresviet" a little later notified to be on fire. The two red destroyers, making for where the submarines had last been seen, were both sunk about this time by blue gun fire.

The submarines discharged three torpedoes at the



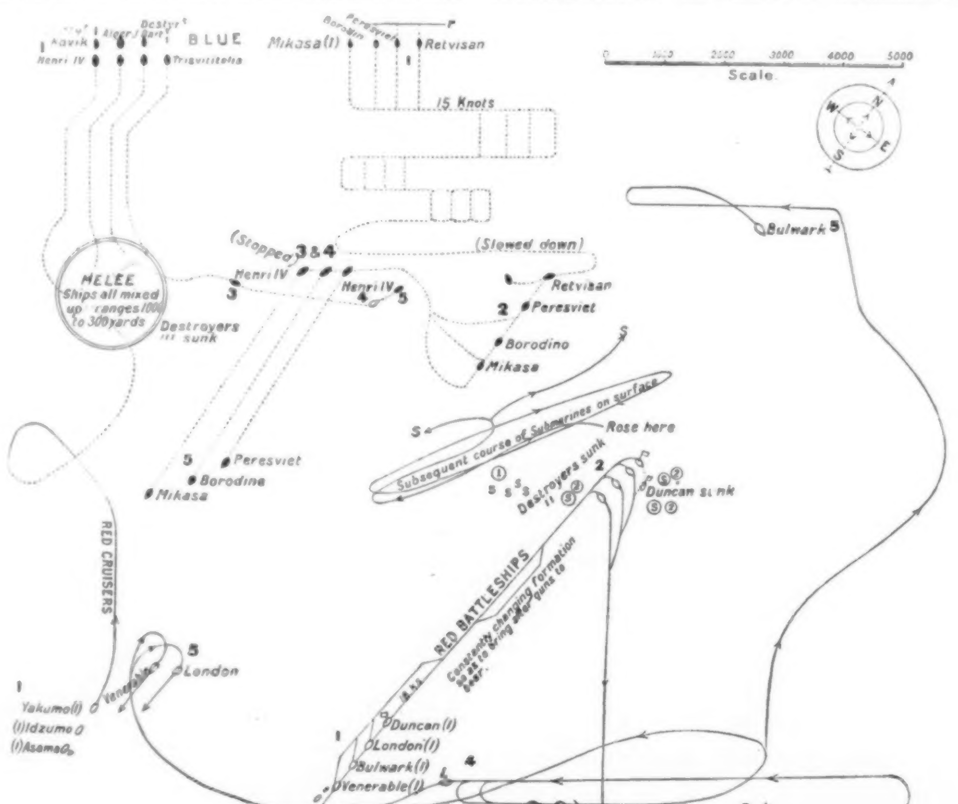
POSITIONS OF THE SECOND DIVISIONS IN THE MELEE

Note.—The Ships here are about twice the size they are in actual proportion, but the relative distances are exact.

the bow on the water-line, once on the after 6-inch turrets by 12-inch shot. Up to 4,000 yards no other hits were made, or rather such hits as were secured did no harm, hitting thick armor or making holes in unprotected upper works.

All this time the submarines were creeping up, rising to the surface every third minute, and after a time running on the surface. A small pin was used to indicate each when up, but the four were within a thousand yards of the "Duncan" before the red side began to be curious about the pins. Then a sudden suspicion came upon them, and every single quick-firer in the four battleships was directed at the submarines, as well as all Maxims. The four pins disappeared—the reds were not allowed to see whether or no they had hit the infinitesimal dot allowed them for target. As a matter of fact, by some pure chance, one boat was hit thrice. Red, however, imagined that all were receding red ships, but secured no hits. One boat rose quite close to the "Duncan"—by this time badly disabled—and without being noticed approached on the surface, and firing again torpedoed her. The other three battleships promptly put 4,000 yards between the submarines and themselves, and so the first stage of the battleship action ended.

Meanwhile the red cruiser division, under a rear-admiral in the "Asama," acting independently, went straight for the blue second division, sinking the three blue destroyers and badly mauling the "Henri IV" with their quick-firing shell. They also blew the "Descartes" to pieces, receiving very little damage in return, as neither of the battleships hit them, though at a near range. A melée followed, and—as usually happens—shooting was extremely wild. Torpedoes, however, were more effective, and in five minutes only two ships were left—the "Henri IV.," torpedoed in the



NAVAL WAR GAME—COURSE OF THE ACTION

sunk; though even then they were not sure whether the pins meant submarines or indicated only some scoring device of the umpires. It was also suspected that blue, whose ships were then going dead slow 4,500 yards away, had claimed and been allowed to use a Brennan torpedo. So red went on without altering course.

Two minutes later the submarines—or, rather, three of them—rose again, once more to be greeted with a heavy fire that was wildly ineffectual. One boat was to starboard, two to port. They had reckoned on the ships turning. As the ships, instead, kept on they were saved this time.

The submarines went under again, and this time the bow, and the "Asama" (red) unhurt. She promptly circled round with a view to giving the "Henri IV." one of her after tubes, and in so doing passed within 3,000 yards of the blue battleships. These fired all their big guns at her, and there was no "Asama" left. The "Mikasa" hit her twice on the water-line with 12-inch shot, the "Borodino" took her on the lower deck, while quick-fire shells burst all over her. She was umpired sunk at once.

The red battleships having by now got clear of the submarines, tried to work round and attack the blue fleet; but the submarines working on an inside circle always interposed. They kept on the surface, and no red ship dared venture within 2,000 yards of them.

For a long time, therefore, the battle was nothing but desultory long-range firing, which lasted till all, or nearly all, the range-finders were notified out of action. Red then tried another plan. The "Bulwark," the only ship still good for full speed, bore round to the north. The "London" headed south at her best speed—12 knots. The "Venerable" followed the "Bulwark" at 15 knots, then suddenly turned round and went after the "London." This split the submarines, which were undecided. As a result the "Bulwark" got within 3,000 yards of the disabled "Retvisan" and "Henri IV." She captured the latter, but dared not approach. Meanwhile the "Borodino," "Peresviet," and "Mikasa" engaged the "London" and "Venerable" at 3,000 yards, but very indecisively. The "London" lost a big gun turret, the "Mikasa" got a shell in the conning tower, which made her temporarily unmanageable, and the "Peresviet" was further mauled. Dread of submarines, however, kept the red ships from following up their advantage, and blue was not disposed to continue the attack; so the fight ended in a species of draw in blue's favor.

In view of the fact that the battle lasted over a period representing three hours, and that some ships fired nearly fifty rounds per big gun, and used up all their quick-firing ammunition, the damage done was very slight. Owing to the angle at which many hits were made, and its modern character, a good deal of the armor was accounted shot-proof, as a rule, as weil as shell-proof. The latest pattern 12-inch gun is allowed a penetration of *aa* (equivalent to 24 inches to 28 inches of iron, or thereabouts) at 4,000 yards. The unarmored cruisers, of course, were terribly shot about and wrecked. The damage to the "Mikasa" is worthy of note; she alone has her quick-firers behind a continuous belt of armor, which theoretically should be a large advantage. Against quick-firers it certainly was, but for big guns the target was a very good one. This the gunnery people always kept in view: they rarely attacked her with quick-firers, but they gave her solid shot from big guns at most ranges. It was at such a distance a "firing into the brown," but the most likely place to hit is amidships. Consequently several 12-inch shot got inside the 6-inch Krupp battery armor. When such projectiles hit a casemate ship amidships, they either passed harmlessly out again, or at the most merely smashed a solitary casemate or two.

A curious question arose in connection with the submarines, of which there were four, though red's estimate of their number ran from seven to twelve. Boat number four having sunk the "Duncan," submerged herself, and in the condition claimed to re-load a tube. In consequence of this she was umpired capsized—under protest from the torpedo officer who played her. The blue side generally regarded the rules as bearing hard upon the submarines. The players of these were not allowed to see the board except when on the surface—then only a hasty distant glance was permitted. The slightest infringement of any rule carried with it the capsizing and loss of the boat as a punishment. On the other hand, it should be borne in mind that the game was played on a table over 12 feet square, upon which it was exceedingly difficult to notice a small pin stuck into the board, and that pins were not invariably used. A speck of paper—the same color as the board—or any other hardly to be noticed article was now and again employed. Red, however, blazed indiscriminately at every speck of dust or anything else within 2,000 yards of its ships. Toward the close of the action, this side claimed to fire lyddite shell into the water with time fuses. The claim was not allowed, but the germ of a defense against submarines evidently lies in this direction. A heavy explosion in the water near a submarine is pretty certain to smash in its sides and sink it. It may not be without interest to note that at one stage of the action the blue side were suddenly seized with a panic that red also had submarines which were about to attack them, and a good deal of ammunition was expended upon imaginary boats. It is not wise to draw any too definite conclusions from war-game results; but this particular game certainly throws a strong light upon the moral effect of submarines. Probably the worst mischief that they will effect in actual practice will be in this direction; it is not easy to see that they will be very dangerous, as yet, to any save disabled ships. It is well to bear in mind also, that in a sense, the submerged portion of every modern warship is to some extent a submarine boat with its submerged tubes. No gun in existence stands much prospect of disabling the motive power of a modern battleship, save as an off-chance. The submerged torpedo must therefore be avoided or else risked. The only main difference is a chance of hitting back. Only let a means of attacking submarines be evolved, and sailors will grow philosophical about its menace. As we have before remarked in The Engineer—a fortune awaits the lucky inventor of an antidote to submarines. The day for pooh-poohing them is past.

Count was kept of the relative losses in personnel. In the ships that survived, the losses, according to the scale usually employed, were:

Red.

"Bulwark"	35 out of 750
"London"	65 out of 750
"Venerable"	35 out of 750
	135 out of 2,250

Blue.

"Mikasa"	145 out of 750
"Peresviet"	110 out of 750
"Borodino"	95 out of 750
"Retvisan"	180 out of 750
"Henri IV."	40 out of 400
	570 out of 3,400

Of the "Retvisan's" loss 100 were in the engine-room department. All or nearly all the crews of sunk ships were presumably lost—for no attempts were made to pick them up during the action. Assuming, however, that blue was able to pick up a quarter after the action, this would make the total losses roughly:

Red.

2,550 out of a total of 4,700, of whom 400 prisoners.

Blue.

2,200 out of a total of about 6,000.

That is to say, red about 53 per cent and blue about 36 per cent. As regards ships that survived, red loss in these was approximately 6 per cent, against 14 per cent in the blue surviving ships. The average in actual battles at sea is said to be about 12½ per cent for the last 150 years or so.—We are indebted to London Engineer for the above article.

MECHANICAL ENAMELING OF IRON.

FOR the enameling of cast iron with glazes having lead as a base, the process most generally employed consists in sifting the material by hand over the pieces

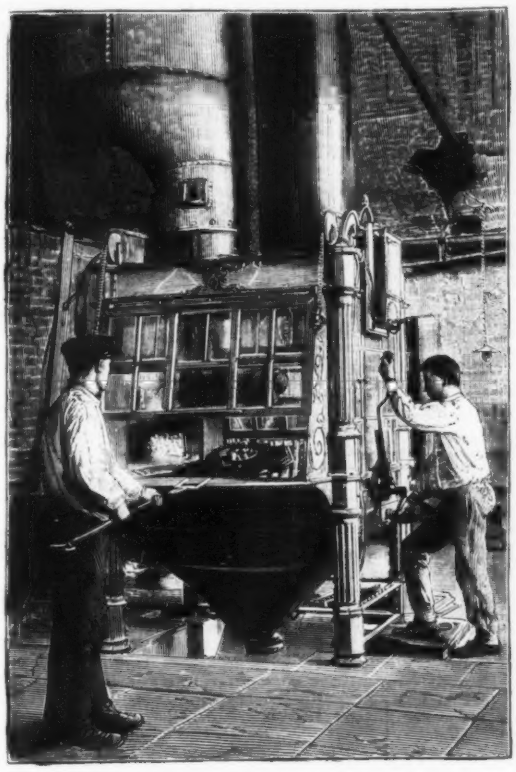


FIG. 1.—MECHANICAL PROCESS OF ENAMELING CAST IRON.

previously raised to a red heat. This process, which is of easy application, permits of obtaining very beautiful products, but the unfortunate workmen employed in such work breathe in dust charged with lead that produces very disastrous effects upon their organisms and exposes them to attacks of saturnism and its terrible consequences — colic, anæmia, paralysis, and general trouble leading to death. Although the workmen have been provided with masks designed to prevent the noxious dust from entering the respiratory tracts, such means have been found inadequate. The workmen, already suffocated by the heat of the furnaces and of the pieces that they are handling, have difficulty in breathing. Besides, it is well to remark that the poisoning is produced, not only by way of the respiratory tracts, but also, and especially, through the pores of the skin. The enameling of cast iron by hand is, therefore, exceedingly dangerous, and produces great ravages among those who are employed in it.

Under such circumstances, it is of the highest interest to make known a new process devised by M. Albert Dormoy, Manager of the Forges et Fonderies of Sougland (Aisne), and which, since it prevents the dust from becoming disseminated through the air, protects the workman against the dangers to which he is exposed.

Upon coming from the furnace, the objects to be enameled are carried by means of forks to a plate placed in the center of a hermetically closed cage formed of two parts, separated by a platform, surrounding the said plate. The upper part is provided, upon two opposite faces, with sliding doors, balanced and fixed to two pitch-chains passing over four rollers. These doors, through which the pieces are introduced, are, as well as the brackets and the other faces of the upper part of the cage, glazed and well puttied, so that the light may penetrate everywhere, while the entrance of air is limited to the doors. Besides, two doors for inspection are formed in the center of the vertical faces.

The upper part of the cage is provided with two circular apertures, one of which serves as a base for a draught chimney of sufficient height to assure the suction of the enamel dust, while the other is traversed by a distributing reservoir that, on the one hand, receives the enamel brought mechanically from the magazine, and, on the other, the enamel that falls to the lower part of the cage, which is raised automatically.

In the interior of the cage, and at a certain height above the movable plate, is suspended a sieve serving for the distribution of the enamel over the pieces, and above which debouches the lower part of the reservoir, which is closed by means of a clack.

The depression caused in the cage by the draught chimney suffices to remove the dust without its being necessary to close the feed door during the operation of enameling. Moreover, the two symmetrical doors of the cage permit of the simultaneous utilization of two furnaces with a single machine and a single gang of workmen.

The lower part of the cage is formed of a polished copper sieve, fixed to a strong cast iron frame, and which receives the enamel not retained by the pieces arranged upon the plate. This enamel is sucked up by means of a small copper tube debouching in the upper distributing reservoir, which has a wide section. In this latter, therefore, there occurs an abrupt expansion which causes the small crystals of enamel carried along to fall into the funnel that terminates it. As to the fine dust, which would mar the beauty of the fused enamel, and which, by reason of its tenuity, is more dangerous to the workmen, that is carried along by a suction tube toward the ventilator, and, at its exit from the latter, is collected and afterward remelted. The enamel, therefore, reaches the reservoir freed from the impalpable dust that might prevent a view of the pieces during the operation.

The movable plate is of iron, cast in a single piece and in openwork. As it rests, through a central pivot, in a step-bearing, forming part of a rocking lever, it is capable of taking on an oscillatory motion. Besides, it is provided with a certain number of small iron rods that project from one-half to three-fifths of an inch, and which, being depressed under the weight of the piece to be enameled, remain upright all around. The piece is, therefore, fixed, despite the oscillating of the plate, which may reach 45 deg. in all directions. The rotation is effected through an external winch that acts upon a system of gearings. The arrangement of the plate and rocking lever is such as to permit of presenting all the points of the piece to be enameled in succession under the sieve, and that, too, under the most favorable inclination.

The sieve is formed of several superposed layers of wire cloth, with large meshes secured to two concentric hoops, strengthened by radii that prevent the wire cloth from sagging under the weight of the enamel. The use of several layers of wire cloth prevents the fouling that would be sure to occur with a single sheet of the cloth. It permits, besides, of obtaining a greater resistance as to the weight of the enamel to be supported. Finally, the small crystals, which fine wire cloth would retain, can easily find a passage for themselves, and this contributes largely to the beauty of the enamel obtained.

The shocks necessary to effect the sifting are obtained by means of electric tappers that may be actuated by any source of electricity, the intensity of

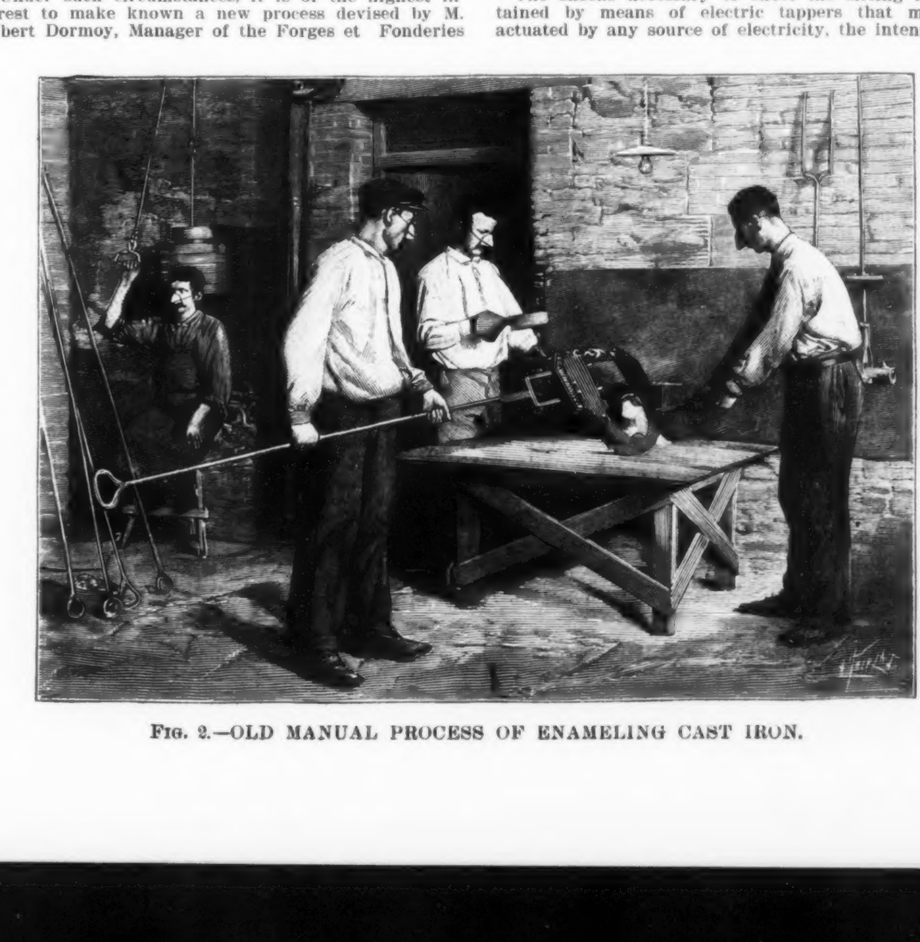


FIG. 2.—OLD MANUAL PROCESS OF ENAMELING CAST IRON.

which may be varied by a rheostat. A current of a power of 40 watts, and consequently easy to produce, gives sufficient shocks. Electric communication is established by means of a pedal performing the role of an interrupter.

The operation of the apparatus is very simple. As soon as the piece to be enameled is taken from the furnace and placed upon the plate, a workman, bearing upon the pedal, sets the tappers in motion; and then, while holding in one hand the lever controlling the rotary motion, and, in the other, the lever producing the oscillation, he presents the different parts of the piece successively under the shower of enamel falling from the sieve. The operation consumes but a very short time, and, as everything takes place in the interior of the cage, the workmen can, without even putting on a mask, proceed with their work without the least danger.—La Nature.

AMERICAN ENGINEERING PROGRESS.*

I. PRESENT CONDITIONS.

IN the course of a series of articles on "American Engineering Competition" which appeared in The Times during the spring of this year (1900) it was stated that British iron and steel makers would be likely to meet serious competitions from the United States as soon as the unusually high demand for iron and steel then existing should have subsided. Statistics were quoted showing how greatly the American trade had expanded during previous years, so that from holding a commanding lead Great Britain had fallen to the third place in the production of steel, the United States and Germany each exceeding us in this respect.

The articles gave rise to a good deal of comment both in England and America, many critics expressing the opinion that they were altogether too pessimistic in regard to British prospects. Whether this were so or not, the author, in now writing again on the subject, is glad of the opportunity of saying that the opinions attributed to the articles were often the result of the critics' own imagination. What the author wished to advance was that the natural mineral resources of the United States, the energy, courage and foresight with which they had been developed, the splendid equipment of the American steel works, and the large scale upon which they were operated would prove a serious menace to our own steel industry whenever the slackening of home demand in America should leave that country with the much-talked-of "surplus product."

Whether the protective system of America would assist or hinder this competition is a question upon which no attempt was made to form a decision; but the policy it renders possible for the Americans to follow, of keeping up the price at home and selling cheap abroad (see The Times of April 20, 1900), does appear as if it would seriously embarrass our own steel-makers for a time, although with whom the ultimate advantage may rest is quite an open question.

There seems now to be dawning the period foretold, for American makers are sending their surplus product, not only to markets that are common to both this country and themselves, but are attacking us in our strongholds at home. The Glasgow correspondent of Engineering, writing at the early part of November, says: "Steel rails continue to be very much depressed, most of the export orders being absorbed by the American mills at prices which British manufacturers cannot at present touch." Speaking of steel plates the same authority states:

"As regards competition the United States makers have sold 100,000 tons for delivery in the United Kingdom. One firm alone is bringing 10,000 tons to the Clyde, and at a rate which shows a difference to the buyer of nearly £4,000 as compared to the prices said to have been asked here. A second Glasgow firm is bringing over fully 50,000 tons of American steel."

Writing from Middlesbrough, another correspondent of the same journal says: "In the manufactured iron and steel trades there is nothing cheering. The reported introduction into this country on a large scale of American and German material is disturbing affairs much." And again, "It is reported that German-made plates are being offered here at £7 5s., so that even with the recent reduction it would appear that home-made articles are still too dear to compete successfully with the production of Germany." The "very serious competition with this country's export trade in manufactured iron and steel, and also a considerable loss of our export trade in pig iron," and the "continued underbidding of local makers for ships' plates, girders, bars, etc.," by foreign manufacturers are also referred to. More specific instances are given of steamers that have sailed from America for Great Britain with cargoes of steel; one of the most significant being that of the "Monkhaven," from Lake Erie to England with a cargo of steel billets. This is said to be the first vessel to carry out what has for some time been the aim of the steel-makers of the central American States, to send steel direct to Europe from their wharves on the Great Lakes. The enterprise of the Carnegie Company is well known, their programme being to employ a regular line of steamers, during the time that lake navigation is open, to carry steel to different foreign countries.

The steel-makers of this country are, of course, aware of the threatened attack on their natural market, and are doubtless taking such steps as appear needful and politic to meet the invader. There is, however, a strong disposition to look on the matter simply as a spurt due to a temporary disturbance of the balance of trade, while many hold that no country heavily protectionist in its settled policy can compete with free-trade Britain. This view may be sound, there is much to be said both for and against it; but, whether American protection will help or hinder in the attack on markets hitherto British, it is certainly needful to our complete defense that no effort should be spared to develop all our resources to the utmost and bring our blast furnace and steel-making practice to the highest pitch of excellence reached in the United States, Germany or elsewhere.

Happily, some of our most thoughtful manufacturers are beginning to realize the need for furbishing the industrial armor, but it is astonishing how blind a large proportion of Englishmen are to the seriousness of this almost new factor in our history. In this they are encouraged by many politicians, public speakers, writers in the press, and others, who, it would seem, are only anxious to say what is popular and to avoid what is unpleasant. A favorite method of putting aside the evil thought that we are not exactly as we might be is to say that the pessimist is ever with us—"that England has been going to be ruined any time these three hundred years;" one commentator on the articles on "American Engineering Competition" even going back to the reign of Elizabeth for a quotation of this sort. One may be very far from saying, to use a too familiar phrase, that "this old country is played out," and yet may bear in mind that we are now at a period that has no parallel in previous history.

During the nineteenth century the development of the factory system, which in turn has been the result of mechanical invention, has caused the scepter of power to pass from the military to the commercial elements of the nation. A hundred years ago historians measured a country's success by battles won or lost, but we now know that commercial supremacy is the first material essential to national greatness. It is not that a navy and an army have become less necessary on that account, for they are needed to guard the trade which supports them and to which they are therefore subsidiary. Moreover, mechanical development has so forced its way into warlike operations that without a great and prosperous commerce the military forces cannot be maintained. True, it is still "the man behind the gun" who will decide the battle; but the gun (and a very good gun too) has to be there, and, for England, the ship to carry it, with all the marvelous complications of machinery that are essential to a modern fleet. We hold our naval supremacy in virtue of our maritime commerce, dependent in turn on our shipbuilding resources. The world has outgrown the period when a Cæsar or a Napoleon (and steam has placed Napoleon nearer to Cæsar than to the present day) could equip an army with simple weapons and march to victory through a subdued continent. Military prowess—always essential—is less a prime factor than of old. In short, the triumphs upon which we most pride ourselves have been chiefly warlike triumphs, and the racial characteristics which have enabled us to win battles, and which still remain with us, are not necessarily those which will best equip us for defense against commercial rivalry.

This brings us to the second and more important respect in which the present differs from the past—namely, the increased extent to which other nations are competing with us in the markets of the world. They are establishing manufacturing industries on a scale that often equals and sometimes surpasses our own. We have never seen anything like it before. Yet we English must make and sell, or starve. In that distant period of Queen Elizabeth, to which one of my critics has referred, we might shut ourselves in our island and wait for the Armada, secure if the Spaniard could not gain a footing on our shores. Foreign trade was a small matter. We could live without it. So it was, though to a less degree, almost up to a time within the memory of men still living. Later the land became insufficient to maintain the people, but that, also for a time, was a matter of small importance, because our inventions and our manufactures brought us wealth by which we could purchase from abroad. Those inventions and manufactures have, in a way, worked against us, for they have been the very instruments in breaking down the barriers of distance, thus establishing equality. Rapid interchange of knowledge, no less than of commodities, has leveled distinctions, making the civilized nations of the earth alike. What is known in England to-day of shipbuilding, of cotton-spinning, engine construction, mining, or almost of any other industry, is known in America, in Germany, or in Japan to-morrow. What is more, all civilized countries see the advantage of a foreign trade and are determined to strive for all of it they can hope to secure.

We were first in the field; we had a long start in the race. A few great master minds—Arkwright, Watt, Stephenson, Bessemer, and others—left a rich legacy of invention to a people hardy, industrious, and enterprising. The mineral resources of the kingdom were developed during a long period of peace and before other nations realized what commerce could do, or had the organization for its development. America, our great rival, was engaged in peopling her vast undeveloped territory; Germany, as we now know her, did not exist, and the other countries seemed to concede to us the role we had allotted to ourselves of "the workshop of the world."

Thus, by the end of the nineteenth century, international commerce had become the ruling factor in the extended prosperity that has fallen to all nations; and it is only during a comparatively recent period that foreign countries have made a determined bid for the share we have held in the world's manufacturing industry. It is these things which differentiate the present from all the past, and which should lead us to reconsider our position. England is no longer the sole heir of her great forefathers; our brothers abroad have claimed their share of the inheritance.

If all this be true it behooves us to ask ourselves whether we are prepared for a contest in a field where, until recently, we met no strong opponent. Only one branch of industry is dealt with here, but that the most important, as being the key of almost all other industries. Are our iron and steel works, our workshops and our organization generally, as far ahead of those of other nations as the advantage our long unchallenged lead should insure, and would insure did we maintain the industrial virtues of the founders of our commerce?

We are rich undeniably, but riches are deceitful—we have the highest authority for that. Moreover, riches bring luxury, and luxury breeds sloth. Is the deceitfulness of our accumulated wealth blinding us to the future that is in store? It was inevitable that we should go back relatively in this industrial race of nations, but in some branches of foreign trade we have gone back absolutely, while our rivals have been forging ahead with giant strides. Sometimes even this may have been inevitable; richer natural resources may have given our competitors an advantage which even experience and possession of the field could not neutralize. Thus, in the iron and steel industry it is the view of some that the natural advantages of the United States are so great that the steel trade must largely fall to America, and that we should do well to get our supplies from that country. This would be an extension, though too great an extension to be desirable, of the lines upon which we have hitherto gone, of obtaining raw material from abroad and working it up into the finished article for the world's markets. The Americans, however, take quite a different view of the matter. They say, "We do not care so much to sell you semi-manufactured products. We would rather keep our iron and steel at home until it is made into steam engines, machine tools, agricultural implements, dynamos, electric motors, and other profitable things of the kind."

That is American policy; what is its prospect of success? How much of the world's expansion will America take from us? How much will she leave for us to struggle over with the other manufacturing nations of the earth?

Apparently that problem will be solved far sooner than has been generally expected. The abnormal demand of the United States for its own engineering products is fast slackening, thus bringing the marvelous increase of American manufacturing capacity of the last five years—perhaps more especially the last three years—to bear on foreign markets. It is the question to us paramount to all others. Even the efficiency of the navy is subsidiary to it; for if we lose our engineering supremacy our naval supremacy will follow, unless held on sufferance of our successful rivals.

* London Times.

SITUATION OF THE NAPHTHA INDUSTRY IN RUSSIA.

THE Russian Minister of Finances appears to be abandoning his project of monopolizing the naphtha industry. He counts on regulating it in other ways, which differ little from monopoly.

The naphtha crisis in Russia presents a special aspect of interest to Western readers not conversant with the peculiarities of economic life in that country.

According to the figures published officially, the price at the point of production, which was, in 1892, 1.8 kopecks per pood, mounted to 6.5 kopecks in 1895, to 7.7 kopecks in 1897, to 12.8 in January, 1899, and to $16\frac{1}{2}$ kopecks in December, 1899. About the close of February of the present year there was a slight fall, leaving the price at 15-$15\frac{1}{4}$ kopecks. The price of the residuum rose from 2.1 kopecks in 1893 to 13 1-5 in 1899, and is now $15\frac{1}{2}$ to $15\frac{3}{4}$ kopecks. Petroleum, which was sold in 1894 at 7.9 kopecks, and in 1896 at 24.3, reached, in December, 1899, the price of 54 kopecks, and in February, 1900, 48 to 50 kopecks. The prices of the different products of naphtha have been multiplied from six to thirteen times, with a force and rapidity not to be met with in any other branch of industry, even in Russia.

During this period the methods of production have been improved, and the aggregate has risen from 190,000,000 poods in 1889, to 525,000,000 poods in 1899. The increase of price, therefore, is to be found in conditions purely commercial. These conditions allow unrestricted freedom in exploitation.

The real cause resides, not in the exhaustion of wells or the cost of working them, but in the combination of the principal producers, which has become possible from the concentration of the Bakoo wells in the hands of a few large capitalists, who are interested in maintaining high prices. The official figures correspond with the successive steps in this concentration. In 1897, out of a total of 107 producers, 38 extracted 86.8 per cent of the whole production. In 1898 the production of 10 firms, out of 140, rose to 64.3 per cent. About the same proportion exists in the case of petroleum. Under these circumstances an understanding among producers becomes easy, and may be regarded as advantageous. According to Russian laws such combinations are subjected to severe penalties. Their existence must, therefore, be kept secret, for they would be considered dangerous for the present and future commercial interests of Russia.

In a country where the naphtha combustible is demanded every year, both by manufacturers and by the railways, which increased their consumption from 5,750,000 poods in 1886, when the supply of coal was not equal to requirements, to 62,500,000 poods in 1896, and where petroleum is in use by the whole population, in such a country the uncontrolled domination of a small group of producers becomes a serious calamity. It may disorganize and ruin many enterprises, and thus may in the end react on the naphtha interest itself, which cannot continue to exist except as a necessity.—Translated from L'Industrie.

Imitations of American Goods in Sweden.—Consul Bergh writes from Gothenburg, January 9, 1901:

My attention has been called to the forks sold by a wholesale hardware dealer of this city as American products. This fork, an inferior imitation of the original, is sold as an "American manure fork" at a price much lower than that for which a genuine American fork can be offered. This is only one sample of the many German imitations offered for sale in Sweden and represented to be "best American goods." This, of course, does great harm to the American trade, as the buyer will soon discover that he has bought an article not worth the money, and will blame the American manufacturer. It causes prejudice against everything of American make. Sweden has no law compelling the mark of origin to be placed on imported goods, and it is very easy for German exporters and Swedish importers to flood the market with this kind of goods. The Swedish law says simply that foreign-made imported goods shall not be marked, stamped, or branded so as to make the purchaser believe that the goods were manufactured in Sweden.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Furniture in England.—The following article from The London Mail of December 27—one of a current series contributed by well-known economic writers dealing chiefly with the question of American competition—was transmitted by Consul McFarland, of Nottingham, under date of December 28, 1900:

THE BRITISH INDUSTRY THREATENED BY AMERICAN COMPETITION.

There is no British industry more seriously threatened by American competition than the furniture trades.

And this is chiefly to be accounted for by the attitude of the British workman, and particularly the London cabinetmaker, toward machinery and improved processes for the saving of labor.

Let me give an illustration. A master cabinetmaker, who is a pushing and up-to-date man, wished to introduce into his workshop a new machine for cutting angles. It did the work at a single stroke and produced a more perfect job than could be obtained by any other device. He also believed that in his particular class of trade the machine would effect a saving of about 5s. ($1.21) a week for each man employed. But he did not want to put the 5s. in his own pocket; he only desired to get better work, so he made the following proposition to his men:

He showed them the machine, and offered to buy it and pay cash for it, and to allow them the use of it at once. They would be paid the same wages as before, provided they would contribute 1s. (24 cents) each per week toward the cost of the machine until it was paid for. Then it would remain in the shop as the men's joint property.

What could be more fair? Had the arrangement been concluded, the men would have been enabled to do an amount of extra work which would have put 5s. a week into their pockets, out of which, for a short time only, they would have had to pay 1s. for the use of the machine. But the offer was unavailing.

The workmen's theory was that there was all too little employment in the cabinet trade already, and that any device for saving labor would do harm to the trade, and so they preferred to go on in the old way.

CABINETMAKING AND SWEATING.

In the west end of London there are a few firms who do a very high-class trade, and who uphold the traditions of English cabinetmaking against the world (with the possible exception of Paris); but their trade is so limited in volume that for the present purpose it may be disregarded. The bulk of the domestic furniture produced in London is made in small workshops and sold to wholesale merchants, who, in their turn, sell to retail furniture dealers, through whose agency it finds its way to the public.

Some of these wholesale houses stipulate that the small maker must buy his wood from them, a practice which is open to the gravest abuse. Furthermore, an order generally represents about a week's work, and the maker has to dispose of it and get the money on Saturday before he can pay his wages and provide for the needs of his own family. It is a miserable trade, and I could say much about it which would reflect more upon the capitalists (I need not call them employers) engaged in the trade than upon the men who have to live by it "from hand to mouth," as the phrase goes.

But we must not run off the rails. The cardinal fact in the situation is that the attitude of the average cabinetmaker toward machinery and improved industrial methods deters capitalists of the better class from embarking their money in the business.

CHEAP AMERICAN LABOR.

A prevalent heresy accounts for the great increase in the imports of furniture to this country from America and elsewhere on the ground that this is not a wood-growing country, and that it is inevitable that where the wood is grown there must the furniture be manufactured.

Such doctrine as this would reduce the great cotton industry of Lancashire to an absurdity; while there are few others which would not be plunged into despair were it once admitted that our manufactures must be limited to the making up of material produced at home.

As a matter of fact, when American office furniture was first introduced here, it came over finished ready for sale and packed in cases. When it is remembered that shipping tonnage is estimated by measurement and not by weight, it must at once be realized that it is infinitely cheaper to import wood than hollow cabinet ware. For example, a roll-top desk of average size for office use would measure, when packed for shipment, about a ton and a half. But a ton and a half of solid wood would make a lot of desks.

This simple statement seems to dispose of the argument that the trade in American office furniture has been developed merely because America is a wood-growing country. It is true that at the present time furniture from the United States is not, for the most part, important except in pieces, which have to be put together and polished in England. But this merely arises out of the competition between importers, who have sought to economize on freight charges and damage in transit, the latter being a considerable item. But I have the authority of one of the largest importers when I say that even the hand work which is done in England costs considerably more than it costs when performed in the American factories, where the men's weekly earnings are at least 50 and in many cases 100 per cent higher than in this country.

At the present time, competition in the cabinet trade from America has been directed chiefly toward office furniture.

In domestic furniture, fashion has to be studied, and the American cabinetmaker is too fully employed with his own market to get out special patterns and lay down the plant needful to cater to English tastes. But, in the opinion of those best able to judge, any American firm of standing which chooses to take hold of any branch of domestic furnishing and cater to the peculiarities of the English market could sweep the field in household furnishing just as it has been swept in the domain of office appointments.

New Railway in British Columbia.—Consul Dudley reports from Vancouver, January 14, 1901:

I am informed that the Great Northern Railway is to build a branch up Big Sheep Creek Valley, in southeastern British Columbia. This will furnish transportation to a mining region of importance, second, perhaps, in the Trail Creek division, only to the section around Rossland. This railway will furnish transportation to the group of miners and mining properties on the west slope of Sophie Mountain, some three of which are in a condition to ship; indeed, it is alleged that these mines can now furnish as large a tonnage of ore as did the mines of Rossland when the first railway was extended thither. In the valley are several promising claims, which have been partially developed, and the railway should cause them to be further operated and turned into large producers of ore.

The opening of the new district will furnish a market for considerable mining machinery of American make. The farmers of eastern Washington will also be benefited by a new market for their produce. Undoubtedly, many American miners and laborers will also find employment in the new district.

Marseilles Cotton-oil Trade.—The statistics for the year 1900 have just been made up and show a distinct loss in the quantity of American cotton oil imported into Marseilles—which continues to be its most important foreign market—as compared with the three years previous, although the average price shows an increase amounting to 14.23 francs ($2.75) per 100 kilogrammes (220.46 pounds). This diminution in the quantity imported seems to have some relation to the increase of arrivals of oleaginous seeds which are crushed by local manufacturers. The total imports of oleaginous seeds have increased as follows during the past four years:

	Tons.
1897	260,000
1898	309,000
1899	327,000
1900	336,452

The necessary result of this increase in the amount of local oil manufactured has been to produce a downward tendency in prices for all oils, especially peanut oil, which last week sold for as little as 50 francs ($9.65) per 220.46 pounds. Since the 1st of January, c. i. f. terms for off-grade cotton oils have been from 52 francs ($10.03), and for prime summer yellow from 54 francs ($10.42), closing strong at the latter rates.

During the year 1900, the price of cotton oil fluctuated in Marseilles from 58 francs ($11.19) in January to 63 francs ($12.15) in November, the year closing at 56 francs ($10.80).

Typewriters in the Netherlands.—The Remington was the first typewriter introduced into the Netherlands, and has been on sale here since 1884. In the beginning, it was difficult to induce Dutch business men to use a machine for their correspondence, especially as typewriters then were not perfected as at present, and sales were small; but by advertising, the Remington paved the way not only for that particular make, but for other machines as well.

The principal typewriters now in use are the Remington, Underwood, Yost, and Hammond, while several less expensive machines, such as the Barlock, Oliver, Umpire, Franklin, Blickensderfer, etc., have been introduced here. The prices are: First-class machines, $100 to $120; second class, $60 to $80; the cheapest machines, about $40.

Lately, a large number of typewriters have been sold at Amsterdam and Rotterdam, but outside of the cities very few are in use. Good machines are in demand, the price being of lesser importance. Merchants do not care whether they have to pay $50 or $100 as long as they get the best.

In proportion to the population of different countries, typewriters are used more in the Netherlands than in Belgium, Germany and France, though less than in the United States and in England.

It is next to impossible to secure reliable figures concerning the sale of typewriters in the Netherlands, as large dealers are unwilling to state facts, while the smaller agents exaggerate their sales. All agents, however, agree in anticipating for the year 1901 an increasing demand in this trade.

American typewriters are now used in this country in government offices, public institutions, typewriter schools, asylums for the blind, lawyers' offices, banks, insurance companies, mercantile agencies, and in some offices of manufacturers.—Frank D. Hill, Consul at Amsterdam.

American Steel Rails in Australasia.—Under date of Melbourne, December 19, 1900, Consul-General John P. Bray transmits the following clipping from The Melbourne Argus of December 14, relative to the success of American firms in tendering for the supply of steel rails and fish plates for government railways in the colony of Victoria:

"The commissioner of railways recently called for tenders for the supply of 17,440 tons of steel rails and 1,880 tons of fish plates, which represent about two years' supply for the existing railways in Victoria. Up to the present time no rails have ever been manufactured locally in large quantities, and it was therefore known that the tenders would have to come from the steel foundries of the Old World. When the time closed, six tenders had been received—most of them through the agent-general in London (Sir Andrew Clarke)—from English, German, and American companies. Mr. Mathieson fully anticipated that the department would have to pay a high price at the present time, but when he examined the tenders he received a pleasant surprise, for the figures quoted were generally below his estimates.

"Messrs. James M'Ewan & Co., Limited, representing the Illinois Steel Company, Chicago, and the Lorain Steel Company, Cleveland, United States, tendered for the rails at £5 17s. 9d. ($28.65) per ton and the fish plates at £7 7s. 6d. ($35.88) per ton, and their tenders were accepted. Two years ago the successful tenderers agreed to supply the steel rails at £4 18s. 6d. ($23.96) per ton and the fish plates at £7 18s. 3d. ($38.50). The railway authorities thought that they would not be able to secure the rails and fish plates for much less than £180,000 ($875,970); but Messrs. M'Ewan & Co.'s tenders work out at about £117,000 ($569,380), so that they were considerably above the mark. An English company recently offered to establish the necessary iron works in Victoria to manufacture steel rails if the railway department would guarantee to give it orders for 10,000 tons of rails a year for ten years. The matter was considered by the late ministry, but nothing came of the project, probably because Victoria does not seem to possess the requisite supply of iron ore."

Ice and Refrigerators in Brazil.—The consumption of ice in Santos, and, indeed, in the State of Sao Paulo generally, is increasing every day. This is due principally to the unceasing demand for ice in the restaurants, hotels and other public places where drinks are served. Foreigners—chiefly Americans, Englishmen and Germans—who are unaccustomed to a tropical climate are loudest in the call for this commodity. No doubt, the use of ice would be far more general if companies similar to those in the United States were organized, to deliver it from house to house. In my opinion, the organization of an ice company here in Santos would prove a profitable undertaking. I visited the fish markets a few weeks ago, and, to my great surprise, discovered that the use of ice was almost unknown there. One dealer informed me, in answer to my inquiry, that ice was not only too dear, but was very difficult to procure. The same conditions exist in the vegetable and meat markets, and it is not surprising that by the end of the day everything in the nature of fresh meat and fish should be pretty well cooked by the heat of this tropical region. I have no doubt but that a large quantity of ice could also be sold to vessels arriving and departing from Santos.

I believe also that American refrigerators would sell well in Brazil. In this State, only the best hotels have refrigerators, though they are beginning to be employed in a few saloons, where they have been found most useful and convenient. So far, however, they have not been introduced to any extent in private houses. When I say that only about one out of twenty meat dealers uses refrigerators, one may judge of the opening here for these useful articles. Properly introduced, there is no reason why they should not meet with a ready sale.—John J. Grimondi, Consul at Santos.

Office Furniture in Germany.—I am advised that in Heidelberg University, near this city, where about fifteen hundred students are in attendance, only a small number of fountain pens are in use, and few, if any, are offered for sale. The students carry ink in bottles to and from classes. It would appear that our lower priced pens should find a market there and in other parts of the district, including Mannheim, where fountain pens are rarely seen.

The attention of American manufacturers has been called to this field as a possible market for safes. I note that a comparatively small number of safes are in use in this city. The few employed are, for the most part, crude-looking affairs, with old-style locks. Judicious efforts on the part of our manufacturers should result in large sales of our medium-sized store and office safes. German offices and stores are rapidly adopting modern furniture, including desks, typewriters, file cases, cash registers, etc., and safes should prove equally as popular.

Improved devices for registering the attendance of employes at factories are being introduced to some extent, though as yet many factories do not employ them. So far as I can learn, the various devices in use in the United States for registering the whereabouts of watchmen employed in factories at night are not used here. As the city of Mannheim and its suburbs are largely devoted to manufacturing and new plants are being constantly added, it would seem that a market in this line might be secured.—H. W. Harris, Consul at Mannheim.

American Electric Plant in India.—Consul Fee reports from Bombay, January 10, 1901, that the steamship "Buceros," sailing direct from the port of New York, has arrived with an electric plant and outfit and a party of engineers and electricians, representing the General Electric Company, of New York, and destined for the Kolar gold fields, near Bangalore, the capital of the native state of Mysore. The Cauvery River, adds Mr. Fee, is to be used as the source of generating the electric power, which will be conducted across the country to the Kolar gold fields. It is expected that this new power will increase the production of the mines and also lessen the cost of working. This plant is attracting considerable attention, not only from the fact that it is American, but also because it is a new departure in gold mining in India.

Reopening of Ports in Colombia.—Consul Ingersoll writes from Cartagena, December 30, 1900, that the decree mentioned in his report of December 10, 1900, was rescinded on the 25th ultimo, the ports of the Gulf of Morrosquillo (Tolu, Covenas, etc.) being thereby reopened to commerce.

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No. 977. March 6.—Present Conditions of Wireless Telegraphy.

No. 978. March 7.—Utilization of Sawdust in Canada—Commercial Uses of Sawdust in Europe—The Becquerel Rays—Bavarian vs. Ceylon Graphite—*Exhibition of Food Articles and Cooking in Belgrade.

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No. 980. March 9.—Wine and Cider Production of France in 1900—Production of Corks in Russia—*Non-inflammable Rubber Tubing—*A New Alloy in Germany—*Mining Company in Liberia—*Mining Company in Peru.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

As Regards the Origin of the Term "Fuchsin," it has been learned latterly that the inventor, Francisque Renard, connected his family name with the above dyestuff by translating the name Renard into German (le renard, der Fuchs—Engl., the fox) and calling the dyestuff "fuchsine."

Bronze Varnish.—Mix equal parts of good linseed oil varnish and copal or amber varnish and stir into this nicely flowing varnish enough fine bronze, e. g., about ¾ pound of bronze to 1 pound of varnish, so that the gloss as well as the coloring are preserved. Rich gold and natural copper are the most popular colors for this process. A thin application is essential for a handsome appearance. The coating has, of course, to be baked (dried) in drying chambers.—Metallarbeiter.

To Render Window Panes Opaque.—For this purpose German bronze factories manufacture a special silver-bronze, with a matt glass luster. Any desired design or pattern can be applied on the glass, e. g., glass doors, which look like etched glass and constitute a pretty decorative effect.

Panes may also be rendered matt and non-transparent by painting them on one side with a liquid prepared by grinding whiting with potash water glass solution. After one or two applications the panes are perfectly opaque, while the room remains as light as before.—Seifensieder Zeitung.

Solid Alcohol.—The solid alcohol, latterly introduced in all sorts of forms, may be easily produced in the following manner: Heat 1 liter of denaturized alcohol (90 per cent) in a flask of double the capacity on the water bath to about 60 deg. C., and then mix with 28 to 30 grammes of well-dried, rasped Venetian soap and 2 grammes of gum lac. After repeated shaking complete dissolution will take place. The solution is put, while yet warm, into metallic vessels, closing them up at once and allowing the mixture to cool therein. The admixture of gum lac effects a better preservation and also prevents the evaporation of the alcohol. On lighting the solid spirit the soap remains behind.—Pharmaceutische Centralhalle.

Preservation of Gum Solution.—Only the smallest part of the gum Arabic solutions, necessary in every office, etc., is used up for pasting. Most of it dries up or spoils in some other way. The cause of this is the bacteria of all kinds always present in the air. For these the mucilage is an excellent ground of subsistence, but the growing of the bacteria destroys the adhesive power of the gum. This may be prevented by a simple and sure remedy. All that is necessary is to put a small piece of camphor in the bottle. Camphor vapors are generated thereby over the mucilage, which kill all the bacterial germs that have entered the bottle. Since neither the vapors nor the solid piece of camphor injure the gum in any way, the latter maintains its adhesiveness to the last drop.—Oesterreichische Farben- und Lack Zeitung.

Loss of Daylight by Frosty Windows.—A number of experiments have shown that far less daylight enters through frozen panes than one would be apt to suppose without previous tests. With a moderate amount of frost work on the windows the volume of incident light was diminished at least two-thirds, while panes covered with a large quantity of frost admitted only one-fifth of the amount of light traversing the non-frozen windows, other conditions being equal. An occasional consumption of two-thirds to four-fifths of the daylight may be of subordinate significance in summer, but the case is different in winter, even if the eye were only remotely as sensitive to differences in light as the skin is to changes of temperature. It is very essential, therefore, to endeavor to avoid frosty panes, not only in workshops, but in rooms of every description, including bedrooms.—Die Werkstatt.

Photographic Adhesive Agents.—Eder & Valenta recommend the following receipts:

I. Soak 40 parts of Cologne glue in 100 parts of water, melt and next add 40 parts of starch stirred with 40 parts of water. Heat the whole on the water bath until completely transformed into a paste, and add 5 to 10 parts of turpentine. This gluing agent must be used luke-warm.

II. Soak 50 grammes of gelatin in 150 c.cm. of water and add 5 c.cm. of amyl alcohol (Trapp & Münch).

III. Soak 100 grammes of gelatin in cold water, pour off the excess of water and melt the gelatin. Then add 150 c.cm. of alcohol, 500 grammes of water, 50 c.cm. of glycerin and 20 drops of carbolic acid.—Liesegang.

Mixtures of starch paste and gelatin are frequently employed for mounting aristo high-gloss pictures.—Deutsche Drogisten Zeitung.

Xylolith, a New Material for Covering Laboratory Tables, etc.—As reported by K. Cehak in the Oesterr. Chemiker Zeitung a hardened compound of sawdust, magnesium oxide and magnesium chloride, prepared into a paste with water and called xylolith, has been used with good success, for the last year, as a table covering at the laboratory for general chemistry of the Vienna technical high school. The material is either stamped, about 2 cm. thick, on the roughened old table tops, fitted with ledges all around, hardening in a few days, or else a finished, ready-made plate of it is fixed on with screws. The covering, which is smoothed down by rubbing with pumicestone after hardening, is distinguished by a light pleasing coloring and perfect impermeability to liquids; it absolutely does not crack, break or warp by the action of moisture or heat, can be washed and may be restored to newness, if desired, by subsequent rubbing down with pumicestone. Concentrated and dilute acids have hardly any action on it. The mass is, after drying, repeatedly saturated with oil, whereby the great absorbing power of sawdust for organic dyestuffs is materially reduced. The xylolith covering, which has also been found excellent as a flooring over the whole laboratory, and can be worked like wood with the gimlet and saw, is likely to prove valuable for restoring old table tops.

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